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REM IV

Remedial Planning Activities
at Selected Uncontrolled
Hazardous Waste Sites – Zone II

Environmental Protection Agency
Hazardous Site Control Division
Contract No. 68-01-7251

82647

CH2M HILL

Black & Veatch
ICF
PRC
Ecology and Environment

File

REM IV

Remedial Planning Activities at Selected Uncontrolled Hazardous Waste Sites–Zone II

Environmental Protection Agency
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Work Plan
for

FEASIBILITY STUDY

EAGLE HARBOR SITE
KITSAP COUNTY, WASHINGTON

July 1989

WA 172-QL62
EPA Contract No. 68-01-7251

CH2M HILL

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Section 1
INTRODUCTION

AUTHORIZATION

This feasibility study (FS) work plan has been prepared under U.S. Environmental Protection Agency (EPA) Contract No. 68-01-7251 and under specific authorization of EPA Region 10 Work Assignment No. 172-QL62.

FEASIBILITY STUDY WORK PLAN OBJECTIVES

The objectives of this document are to:

- Present a summary of the preliminary results of the Eagle Harbor Remedial Investigation (RI)
- Identify site-related data needs important in evaluating remedial alternatives
- Describe the tasks that will be conducted to fill these data needs
- Describe the methodology that will be used to evaluate a range of remedial alternatives for Eagle Harbor intertidal and subtidal sediments
- Present the estimated schedule for conducting these tasks
- Identify the project team and organization that will be used to accomplish the FS tasks as described
- Present the subcontracting plan

Section 1 presents a summary of the site background, an overview of the RI results, data needs, and an overall discussion of our approach to conducting the remedial alternatives feasibility study.

Section 2 describes the field and data evaluation tasks that will supply additional information to the alternatives evaluation. This section also describes the specific tasks related to remedial alternatives development and evaluation.

Section 3 presents the estimated schedule and task flow diagram.

Section 4 presents the project team and organizational structure, while Section 5 summarizes the subcontracting plan.

BACKGROUND

The following summary is based on information presented in the June 1989 draft Remedial Investigation (RI) report for the Eagle Harbor site (CH2M HILL, 1989a), prepared for EPA by CH2M HILL. Eagle Harbor is a small embayment located in central Puget Sound on the eastern border of Bainbridge Island, shown in Figure 1-1. The bay is about 2 square km in area. The inner and outer bays contain small marinas, the Washington State Department of Transportation (DOT) ferry terminal and maintenance facility, marina repair facility, and the Wyckoff Company wood treatment facility (Wyckoff facility). The marina repair facility and the ferry facilities are on the site of the former Hall Brothers shipyard. This north shore shipyard area was once the largest shipbuilding facility on the west coast.

Previous investigations by the National Oceanic and Atmospheric Administration (NOAA), Washington State Department of Ecology (Ecology), and EPA have shown that Eagle Harbor sediments and clams are contaminated with polynuclear aromatic hydrocarbons (PAH). NOAA also found PAH accumulation in the liver tissue of English sole, a bottom fish. Lesions were found on the English sole that are indicative of contaminated sediments. In 1985, the Bremerton-Kitsap County Health Department issued a health advisory against eating shellfish from Eagle Harbor.

The groundwater and soils at the Wyckoff facility and sediment in the adjacent harbor are contaminated with PAH, a component of the creosote used for wood treatment. Metals are a secondary contaminant of concern and can be found throughout the harbor, with highest concentration in sediments near the north shore shipyard area as well as west of the Wyckoff facility. Metals such as mercury, lead, copper, nickel, and zinc may have originated from marine paint residue.

The Wyckoff facility and Eagle Harbor were proposed as one Superfund site on EPA's National Priority List (NPL) in 1985 and were finalized in July 1987. The Wyckoff/Eagle Harbor Superfund site is divided into three operable units (OU):

1. Eagle Harbor, including subtidal and intertidal sediments

2. Wyckoff facility

3. Other sources of contamination that may be identified

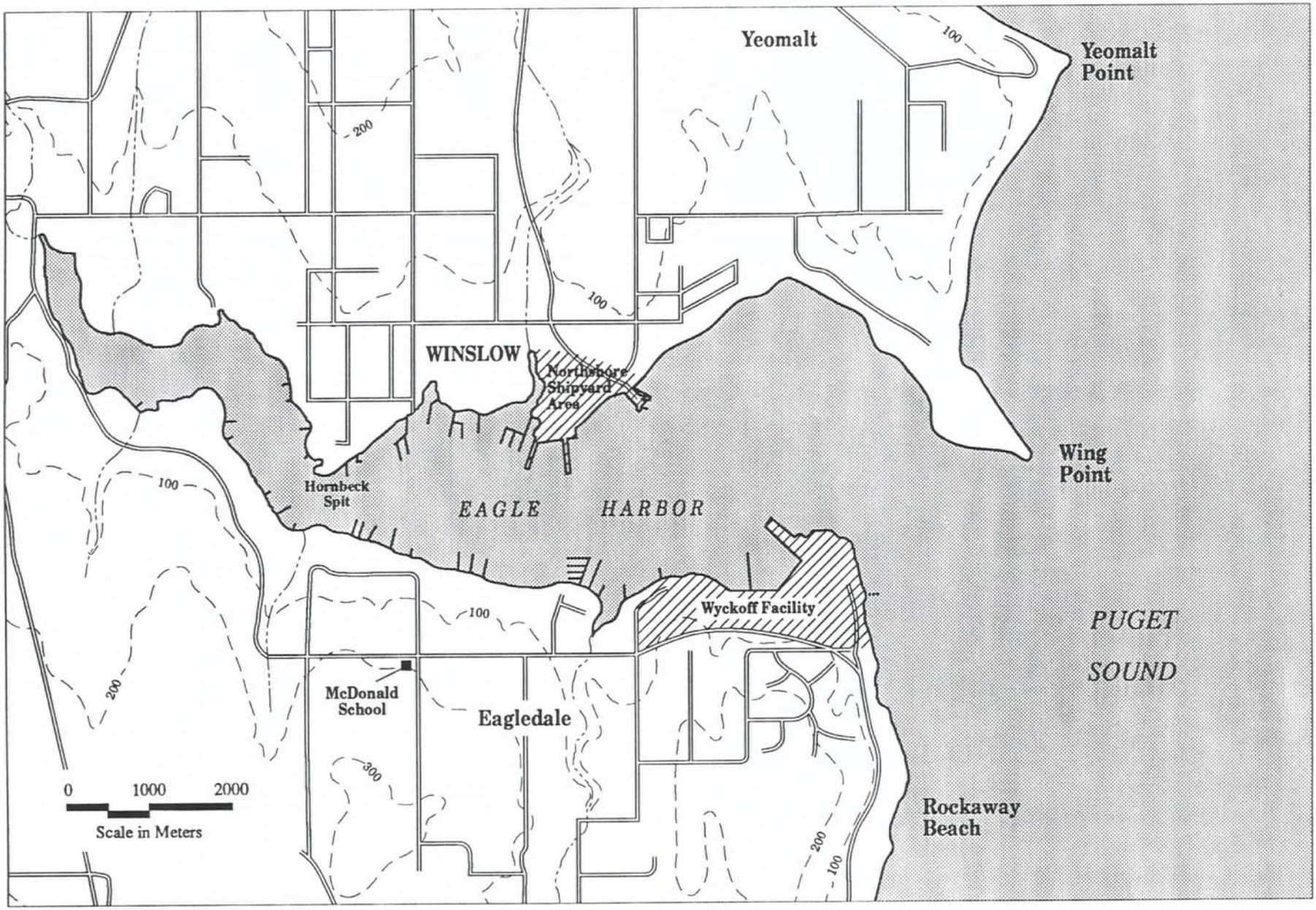


Figure 1-1
WYCKOFF/EAGLE HARBOR SITE

In September 1987, EPA contracted CH2M HILL to conduct a remedial investigation and feasibility study (RI/FS) of the Eagle Harbor OU. This work plan presents the preliminary results of the RI and describes the tasks to be completed for the Eagle Harbor OU Feasibility Study (Eagle Harbor OU FS).

The Wyckoff facility shallow groundwater contamination is being addressed simultaneously by the Wyckoff Company through an Expedited Response Action (ERA) under a consent order with EPA. The RI/FS of the Wyckoff OU, not yet scheduled, will be conducted by EPA or the Wyckoff Company. The need for an RI/FS for a third OU will be determined during the Eagle Harbor FS.

REMEDIAL INVESTIGATION OVERVIEW

The following discussion summarizes the preliminary conclusions of the RI report (CH2M HILL, 1989a). Most conclusions are presented in detail, along with supporting evidence. However, in some cases, such as the PAH pathway to the central harbor, there is uncertainty in the conclusions, and the need for additional data is specified. The approach for collecting the additional data during the FS is also summarized.

PRELIMINARY REMEDIAL INVESTIGATION CONCLUSIONS

Physical and Ecological Characteristics

Physical Characteristics. The physical characteristics of Eagle Harbor of interest in the evaluation of potential remedial measures are the wind-, tide-, and ferry-induced currents and sediment depositional areas and rates. Figure 1-2 shows the circulation patterns reported during the RI, excluding ferry-induced effects. The intermittent ferry-induced currents have been estimated to affect the area shown in Figure 1-3. Actual effects will depend on the tidal condition at the time. Sediment depositional areas have also been estimated, shown in Figure 1-4.

Preliminary information regarding Eagle Harbor sediment depositional rates provided by Hart-Crowser (1989) indicates that in some areas of the deeper inner harbor, sediment may have accumulated at a rate of 1 to 1.7 millimeters per year. Other depositional areas include the shoal off the Wyckoff facility and the immediate vicinity of harbor streams. Sediment probably does not accumulate in the central harbor where excessive PAH has been found ("hot spot"). The FS will further evaluate the sediment deposition in the harbor, especially in areas considered for remedial measures.

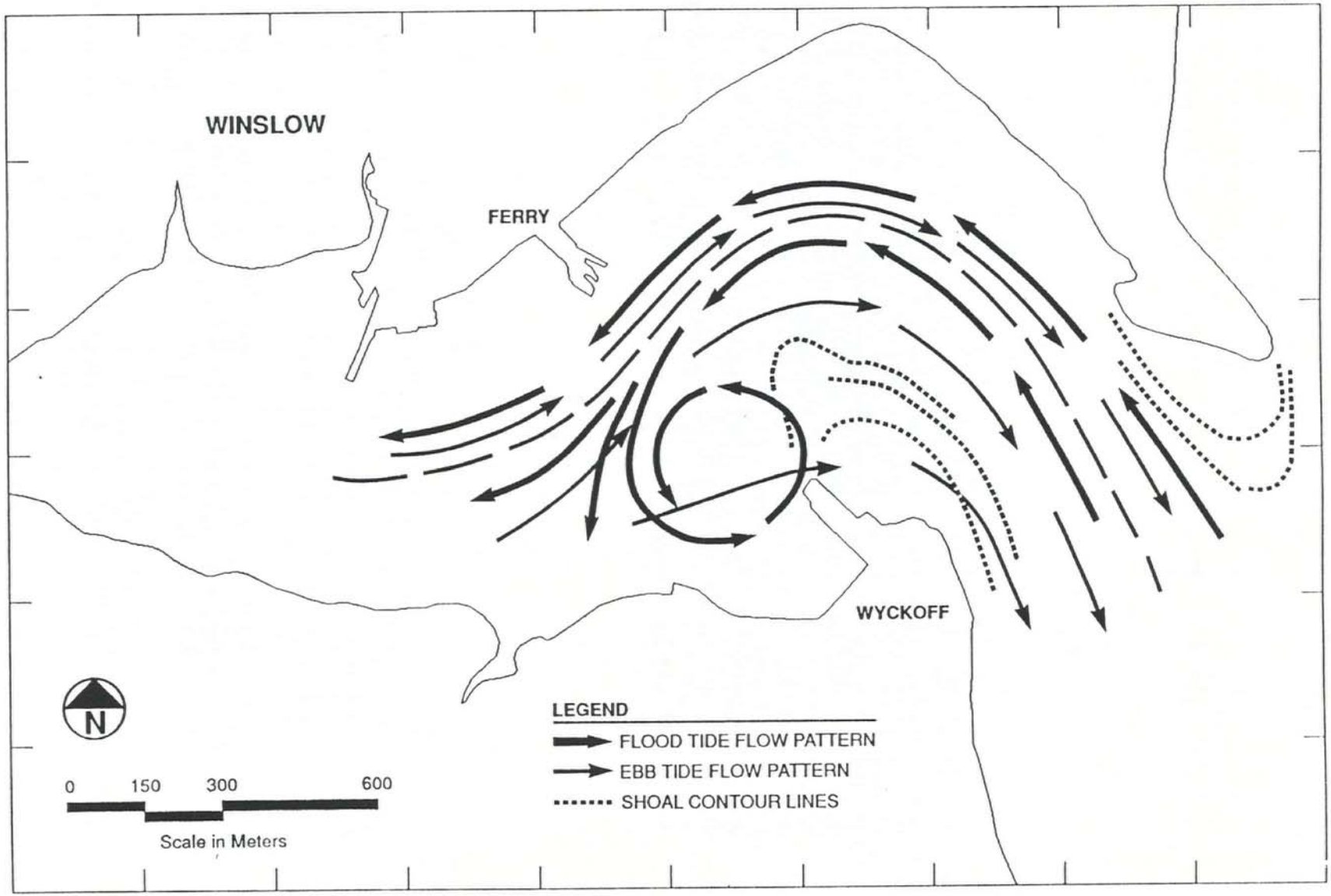


Figure 1-2
LOCATION AND PROBABLE CIRCULATION PATTERNS WITHIN GYRE REGION DURING FLOOD AND EBB TIDES

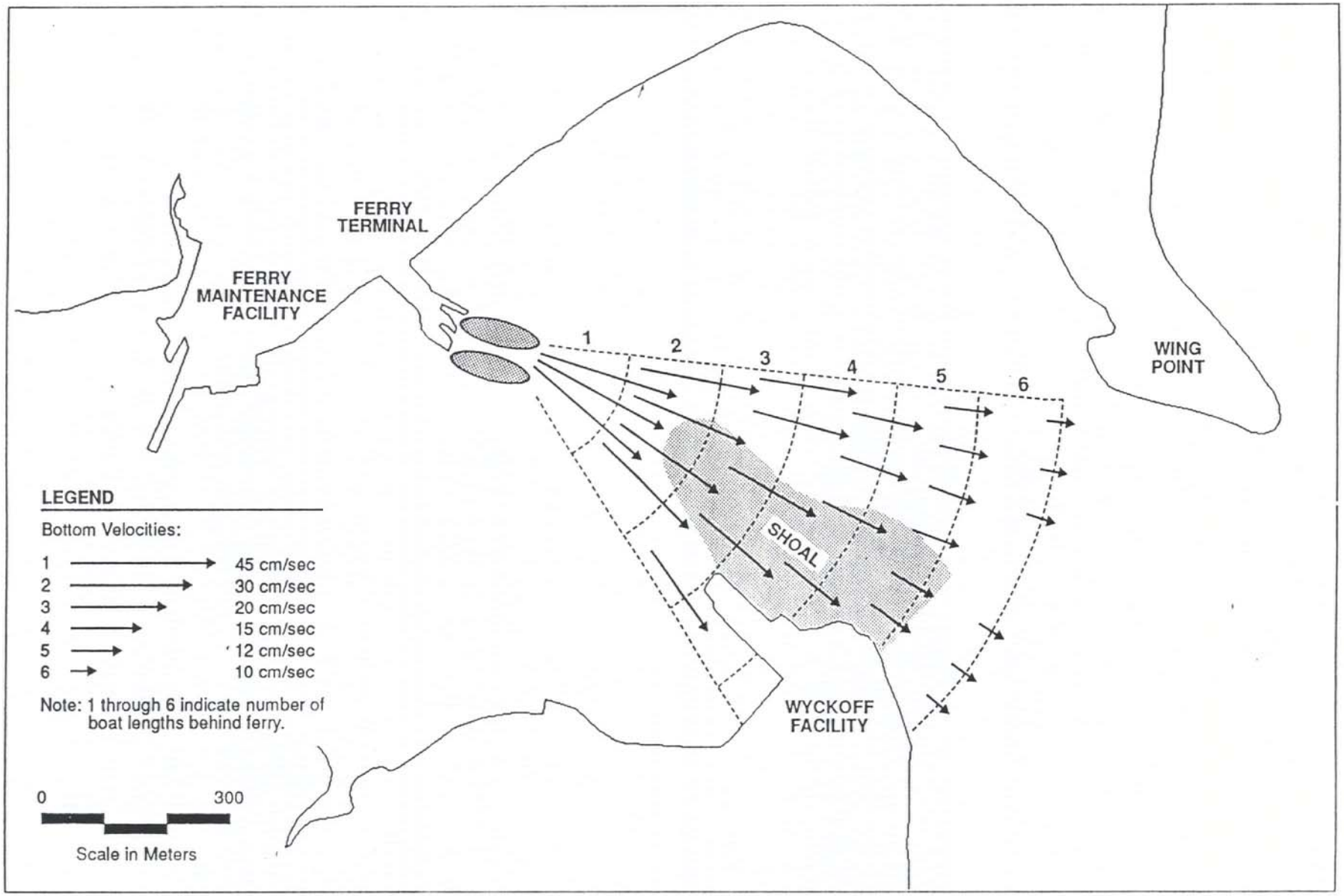


Figure 1-3
PREDICTED AREA OF FERRY PROPELLER INFLUENCE

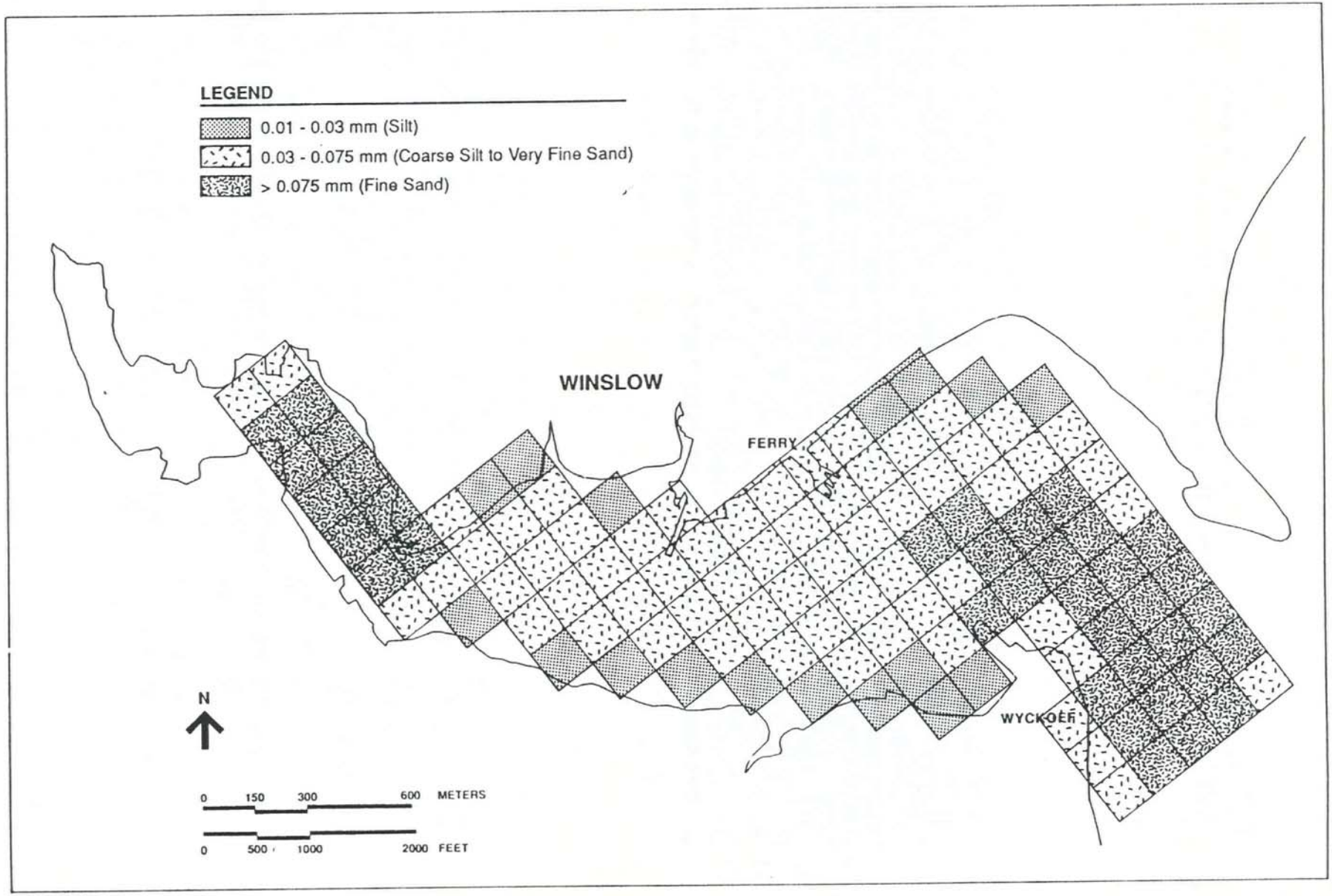


Figure 1-4
AREAS OF POTENTIAL DEPOSITION FOR FINE-GRAINED SEDIMENT AS PREDICTED BY TRANSPORT MODEL

Ecological Characteristics. About 20 species of fish can be found in Eagle Harbor, with English sole being the most common. All major phyla of benthic invertebrates typical of Puget Sound are also present in Eagle Harbor.

Field observations indicate that, in general, the biota of the harbor mix the top 10 centimeters of sediment; some larger clams in the central harbor are capable of mixing sediment to 1 meter in depth.

Nature and Extent of Contamination

PAH. A large area of subtidal sediment in Eagle Harbor contains PAH at concentrations higher than Puget Sound reference areas. The major contamination has been found in the central harbor hot spot, in and around the log rafting areas off the Wyckoff facility, and to a lesser degree, in the vicinity of the ferry maintenance facility. Highest concentrations of intertidal sediment PAH were observed at the Wyckoff facility and at the ferry terminal and Bainbridge Marine Service areas. Figure 1-5 shows the range of total molecular weight PAH (TPAH) concentrations reported in the RI.

Within-area distribution of PAH was found to be variable. Horizontal variation was found between duplicates and among samples taken from the same station during different sampling events. Vertical variation was also noted in the top 50 cm of the sediment, the limit of sample analysis to date. Some of the most contaminated sediments were found to increase in concentration with depth. Figure 1-6 diagrams visual contamination observed in the surface sediments (less than 2 feet).

Metals. The preliminary list of metals of concern includes antimony, arsenic, cadmium, copper, lead, mercury, nickel, and zinc. Highest concentrations were observed on intertidal transects near Bainbridge Marine Service. One intertidal station near this facility had concentrations 10 to 100 times higher than subtidal sediment. This station was in a small area near the dry dock of the old shipyard where paint fragments and sand blast grit probably accumulated.

Subtidal sediments showed the following pattern: highest concentrations of arsenic and cadmium west of the Wyckoff facility and highest concentrations of copper, lead, mercury, and zinc in the vicinity of the north shore shipyard area.

Sources of Contamination

PAH and several metals are considered to be contaminants of concern in Eagle Harbor. PAH are found widespread in the environment resulting from burning, degrading, and direct

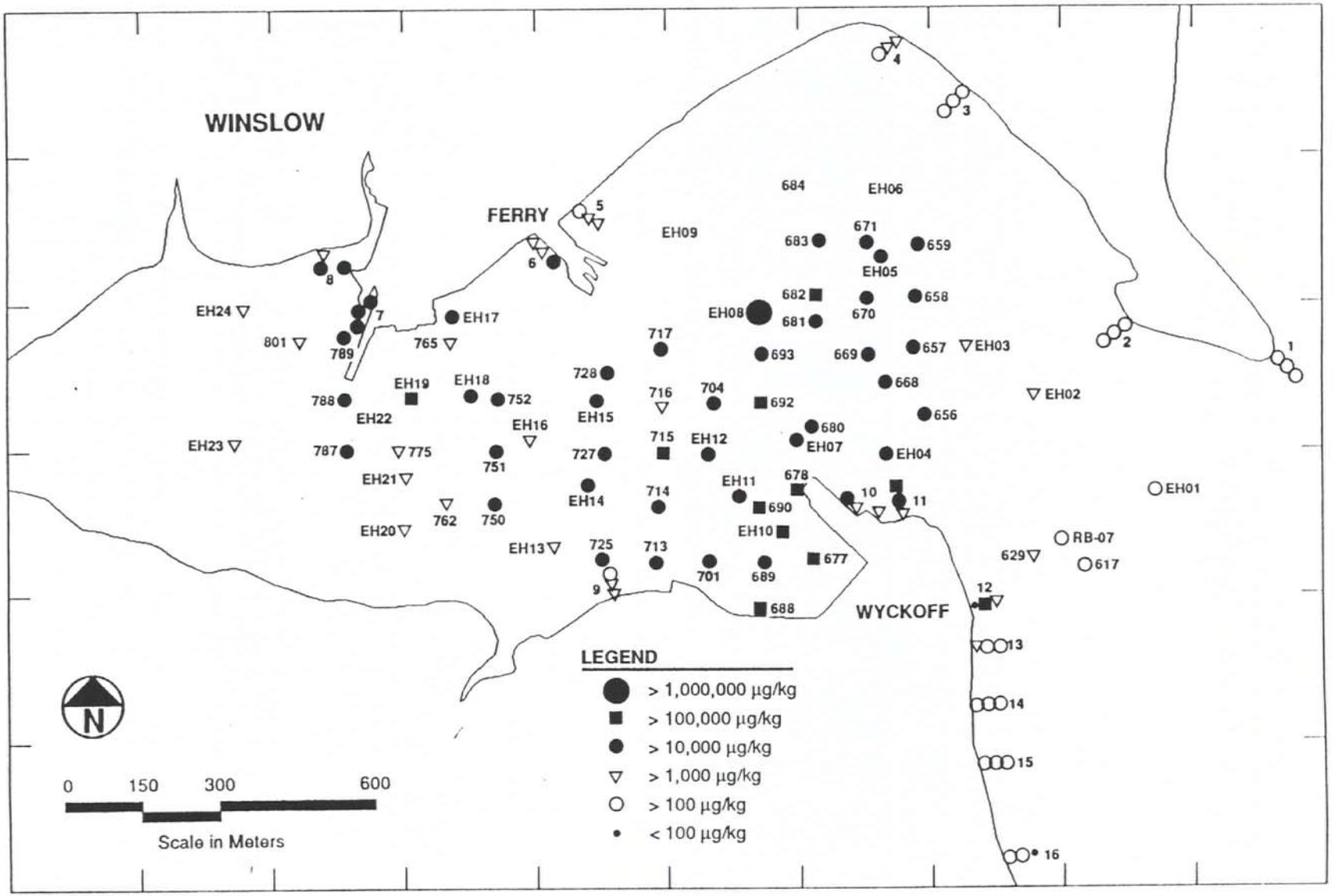


Figure 1-5
CONCENTRATION RANGES OF TPAH
AT STATIONS SAMPLED IN JUNE 1988
AND BY TETRA TECH (1986)
(Sampling depth ranged from 0 to 50 cm)

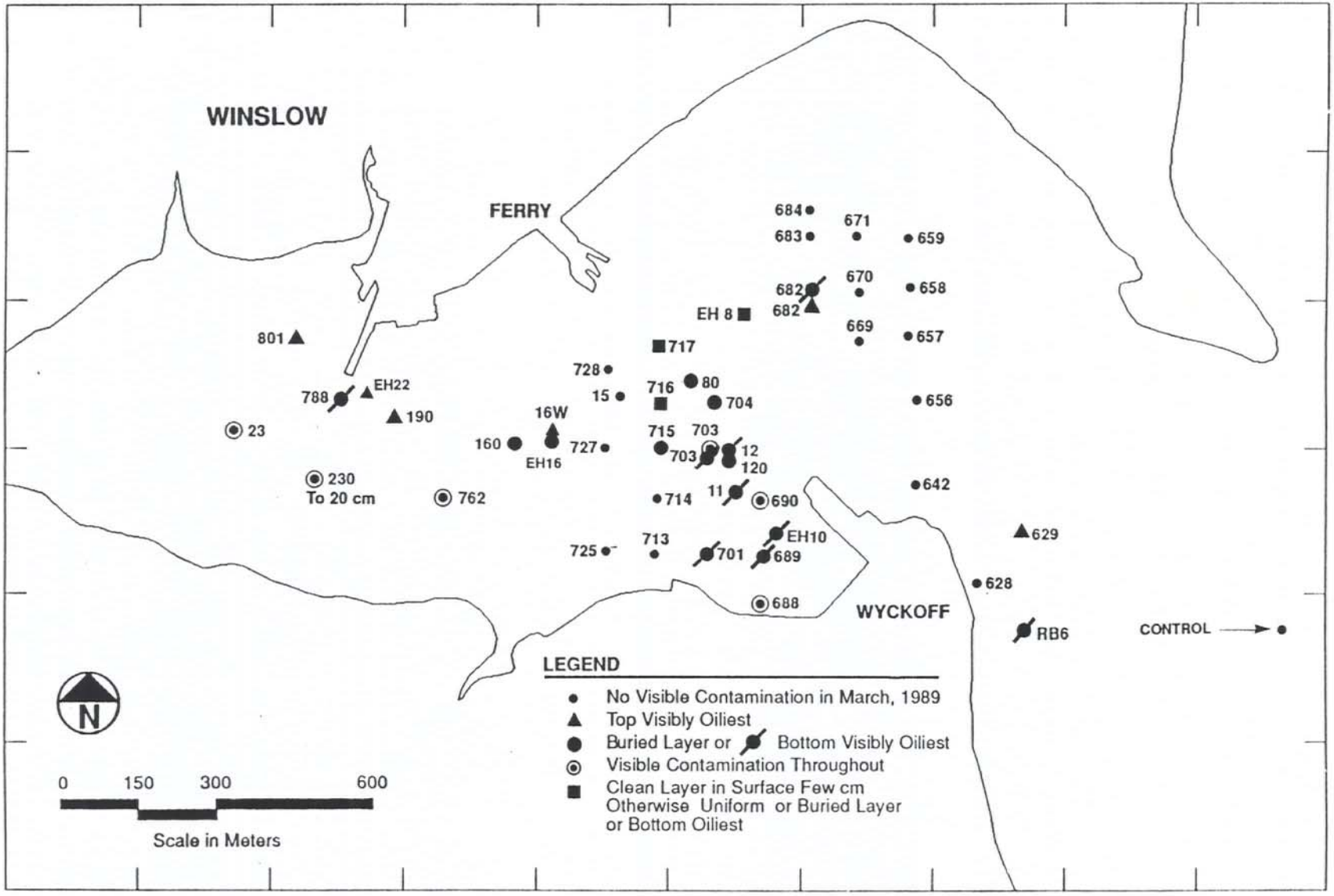


Figure 1-6
OBSERVED PATTERNS OF VERTICAL DISTRIBUTION OF CONTAMINATION

releases of organic materials such as logs, creosote, and fossil fuels. The past industrial uses of Eagle Harbor indicate that PAH could have resulted from all of these potential sources. Because of the importance of understanding past and present primary sources during alternative evaluations, a more definitive evaluation of potential major sources, including a chemical fingerprinting analysis, will be conducted during the FS.

PAH. Documented seeps along the shoreline indicate that the Wyckoff facility is a continuous source of PAH to Eagle Harbor. Creosote operations at the Wyckoff facility location are also believed to account for the presence of PAH reported in the log rafting area. The source of the central harbor hot spot is not clearly understood. There are four hypotheses regarding its origin:

1. A direct dump or spills of creosote

2. Spills or seeps at the Wyckoff facility that flow by gravity to deeper portions of the harbor

3. Deeper subsurface flow of dense nonaqueous-phase liquid (DNAPL) creosote or creosote/fuel oil mixture above low permeability geologic strata from the Wyckoff facility with discharge to the central harbor

4. Undocumented dumps or spills of other PAH-containing material, such as fuel oil

Data currently available indicate the central harbor PAH is related to creosote; however, fuel oil may have contributed to the PAH contamination reported in other parts of Eagle Harbor, specifically along the west side of the north shore shipyard area.

Metals. The major sources of metals to Eagle Harbor appear to have been past shipbuilding and repair activities on the north shore shipyard area.

Fate and Transport of Contaminants

Fate (degradation, burial, or persistence) and transport (dilution and removal) mechanisms of contaminants were evaluated in the RI. Some estimates of the rates of the various fate and transport processes will be required for evaluation of remedial alternatives.

PAH. Transport of PAH involves three primary mechanisms:

1. Adsorption to and transport/deposition of sediment particles

2. Solution in water

3. Separate flow of nonaqeous-phase liquid (NAPL)

Available information indicates that the third transport mechanism may be the most important at Eagle Harbor.

Biodegradation and burial are expected to be the dominant processes affecting persistence of PAH in Eagle Harbor.

Metals. Fate and transport of metals in Eagle Harbor are affected by their solubility and bioconversion to more mobile forms. For cadmium, copper, and zinc, some losses from sediment may occur through dissolution. Mercury is probably mobilized by biologically mediated methylation, transport by organisms, and attachment to transportable organic matter. However, burial is likely to be the most important long-term process by which metals are removed from the biologically active zone.

Risk Assessment

There are risks to public health and the environment from contaminants that have been released to sediment in Eagle Harbor. Figure 1-7 diagrams potential primary sources, release mechanisms, exposure routes, and potential receptors.

Public Health Risks. Risks to public health from exposure to contaminants in sediment, fish, and shellfish from Eagle Harbor were calculated from residential, industrial, and incidental public exposure scenarios. These risks were compared to background risks from exposure to the same chemicals at other locations in Puget Sound.

Calculated risks show that consumption of contaminated shellfish is the major source of potential risk, with estimated excess cancer risks ranging from 1×10^{-6} (average exposure) to 4×10^{-4} (upper bound scenario). In general, these estimated increased risks from exposure to Eagle Harbor concentrations were 2 to 10 times higher than estimated increased risks from exposure to Puget Sound reference concentrations.

Risks from exposure to noncarcinogens (also mainly from the consumption of shellfish) indicate that exceedances of health-based guidance levels could occur from exposure to Eagle Harbor noncarcinogenic contaminants.

Ecological Risks. A noticeable absence of benthic animals exists in the vicinity of some intertidal creosote seeps near the Wyckoff facility and areas of intertidal contamination at the north shore shipyard area.

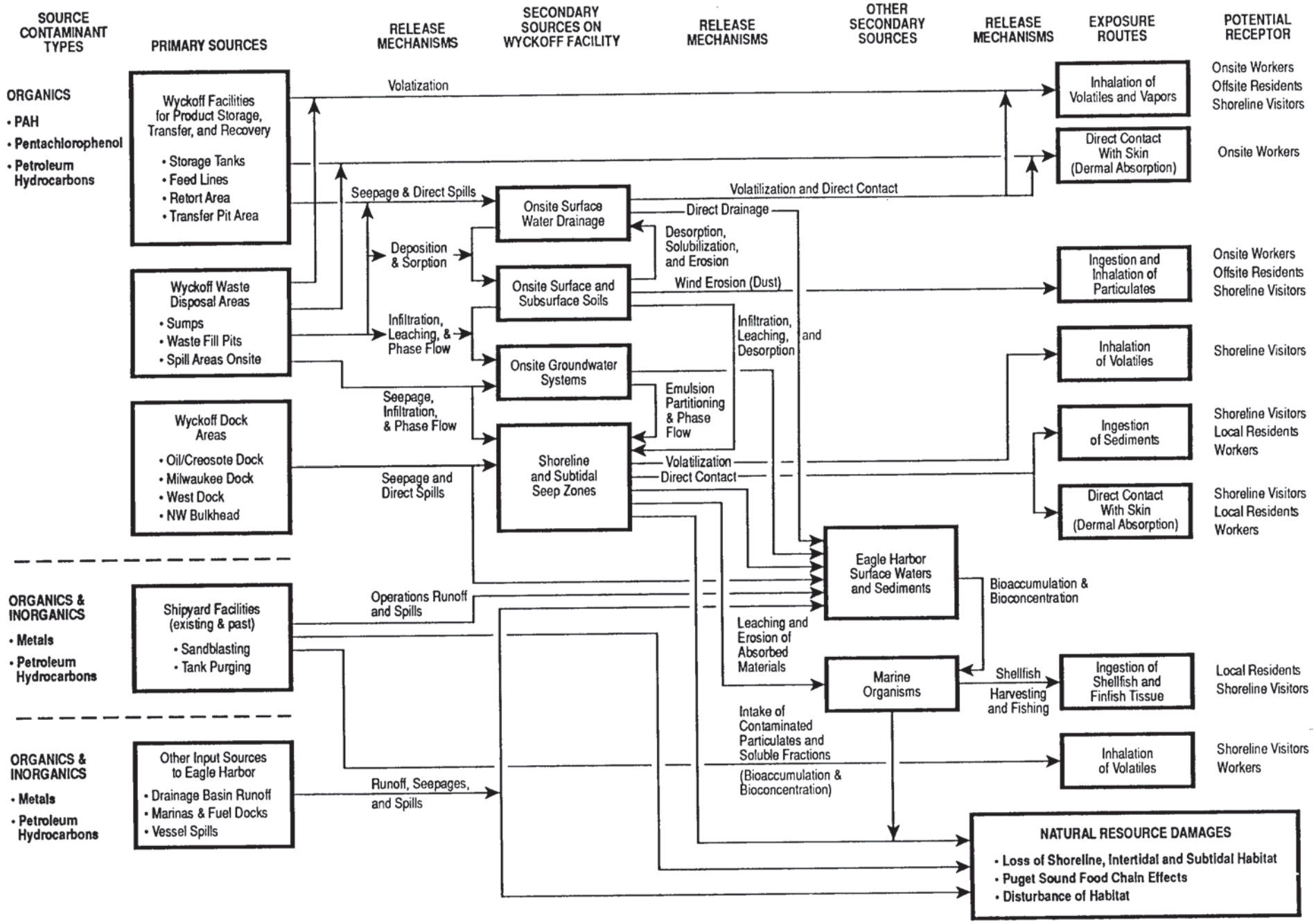


Figure 1-7
WYCKOFF/EAGLE HARBOR SITE CONCEPTUAL MODEL

Bioassay results indicated some subtidal sediment was extremely toxic, including sediment from the central harbor hot spot and the Wyckoff log storage area outward toward the ferry terminal.

Longer-term toxicity effects to aquatic animals in Eagle Harbor include tumors and lesions in some fish and suppression of ovarian development in English sole.

Abundances of major taxa of benthic animals were not significantly lower in Eagle Harbor than in background areas. One group, polychaetes, was found to be more abundant. Enhanced polychaete abundance has been used as an indicator of organic contamination ion other areas, including Puget Sound.

Concentrations of metals in the subtidal sediment were generally lower than concentrations associated with observable benthic biota effects. Bioassays using subtidal sediment from Eagle Harbor did not indicate any effects from metals.

PRELIMINARY REMEDIAL ACTION OBJECTIVES

Preliminary remedial action objectives (RAO) as discussed below were defined during the RI to aid the development of this FS work plan and to assist in early screening of remedial technologies. As discussed later in this work plan, the RAOs will be further defined during the early phases of this FS and will be the subject of a technical memorandum.

The State of Washington (Ecology) is currently developing sediment-quality standards that are scheduled to take effect in July 1990, but the numeric values proposed will be published in July 1989. Ecology has provided a working estimate of likely values for the contaminants in Eagle Harbor.

The preliminary RAO is to achieve the expected sediment standards within 8 years. Concentrations of PAH and mercury exceeded the expected standards in most portions of Eagle Harbor.

After the sediment-quality standards are made final, they will become state applicable or relevant and appropriate requirements (ARARS) and will strongly affect clean-up goals for Eagle Harbor. The RAOs will then be revised to meet the state's sediment-quality criteria.

In developing the standards, the State of Washington has recognized that some less contaminated areas that exceed standards may recover naturally when sources of contamination are eliminated. The planned regulations are expected to have provisions for the allowance of "recovery zones." These are areas where standards are exceeded but will recover naturally in a reasonable time in the absence of remedial action other than control of sources.

It is anticipated that some part of Eagle Harbor (for example, the central harbor hot spot) may require remedial action while other parts may become part of a recovery zone.

Chemicals of Concern

The priority pollutant PAH and associated chemicals, such as alkylated PAH and nitrogen-containing aromatic compounds (NCAC), are considered chemicals of concern because of their long- and short-term toxicity to aquatic animals, their contribution to public health risks through consumption of shellfish, and their exceedance of the apparent effects threshold (AET). An AET is the concentration of a chemical in sediment above which a particular adverse biological response has always been observed. Of all the organic and inorganic compounds reported in Eagle Harbor, only PAH and mercury were found to exceed Ecology's proposed AETs.

Areas of Concern

In anticipation of the proposed Ecology sediment-quality criteria, the portions of Eagle Harbor that exceed likely sediment criteria are designated as areas of concern. Figures 1-8 and 1-9 show the areas of concern for PAH and mercury, respectively. Within the areas of concern for PAH are smaller areas where actual biological impacts have been observed (depressed abundances or mortalities in bioassays by Malins et al. (1985) and the Preliminary Investigation (Tetra Tech, 1986) or mortalities in bioassay tests in the RI. The portions of Eagle Harbor with observed biological effects and with the highest concentrations of PAH in the sediment have been designated as special areas of concern.

DATA NEEDS

Existing Eagle Harbor data will be further evaluated in the FS to provide the following:

1. Detailed description of probable upland, groundwater, and subtidal sources of contamination; historical and present industrial and nonindustrial practices that may contribute to contamination in Eagle Harbor (in more depth than the summary presented in the RI); historical dredging activities within the context of contaminant distribution

2. A summary of current and proposed future activities within the harbor (such as dredging for an improved ferry channel or expansion of the ferry maintenance facility) so that the interactions with remedial alternatives can be evaluated

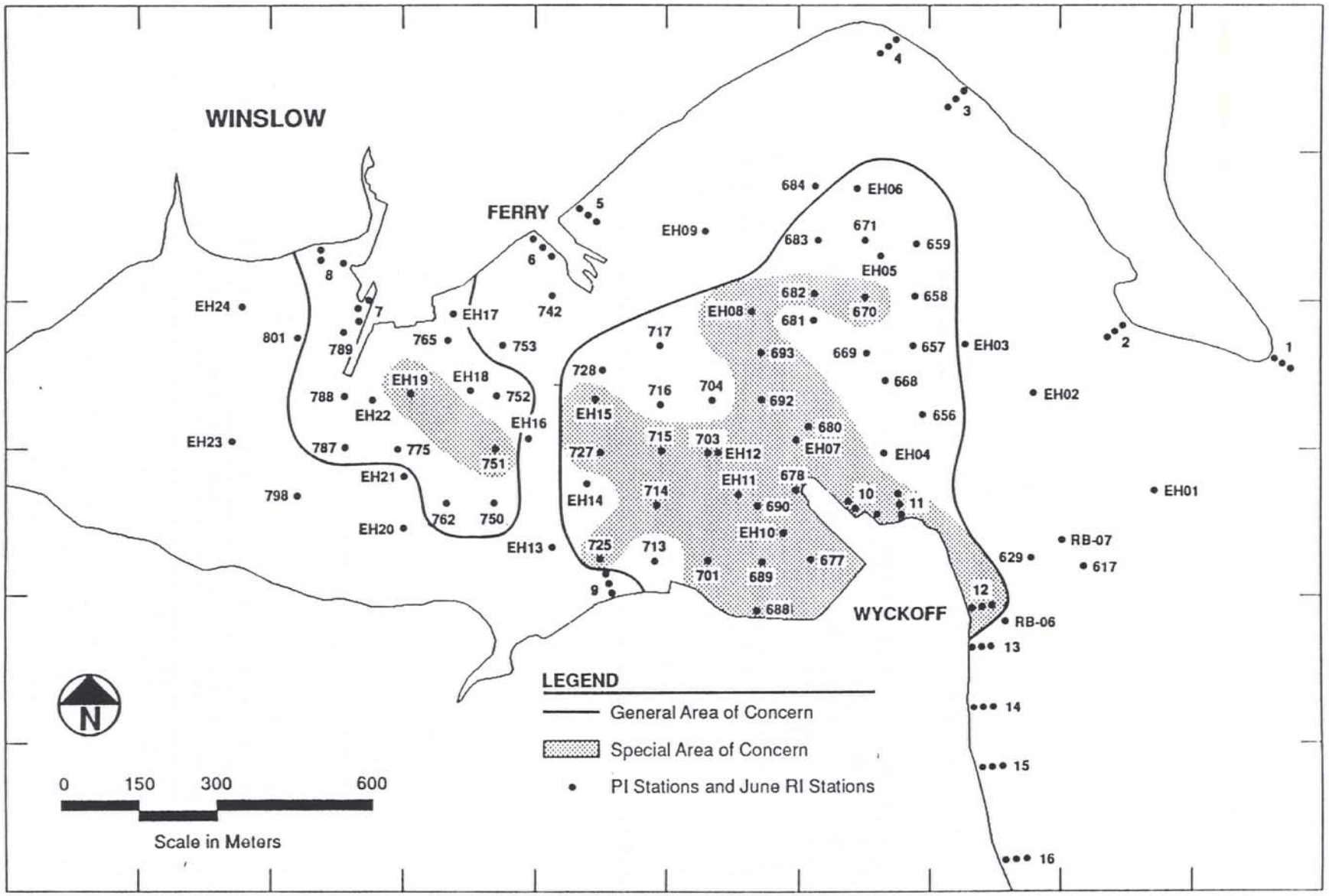


Figure 1-8
AREAS OF CONCERN OF PAH

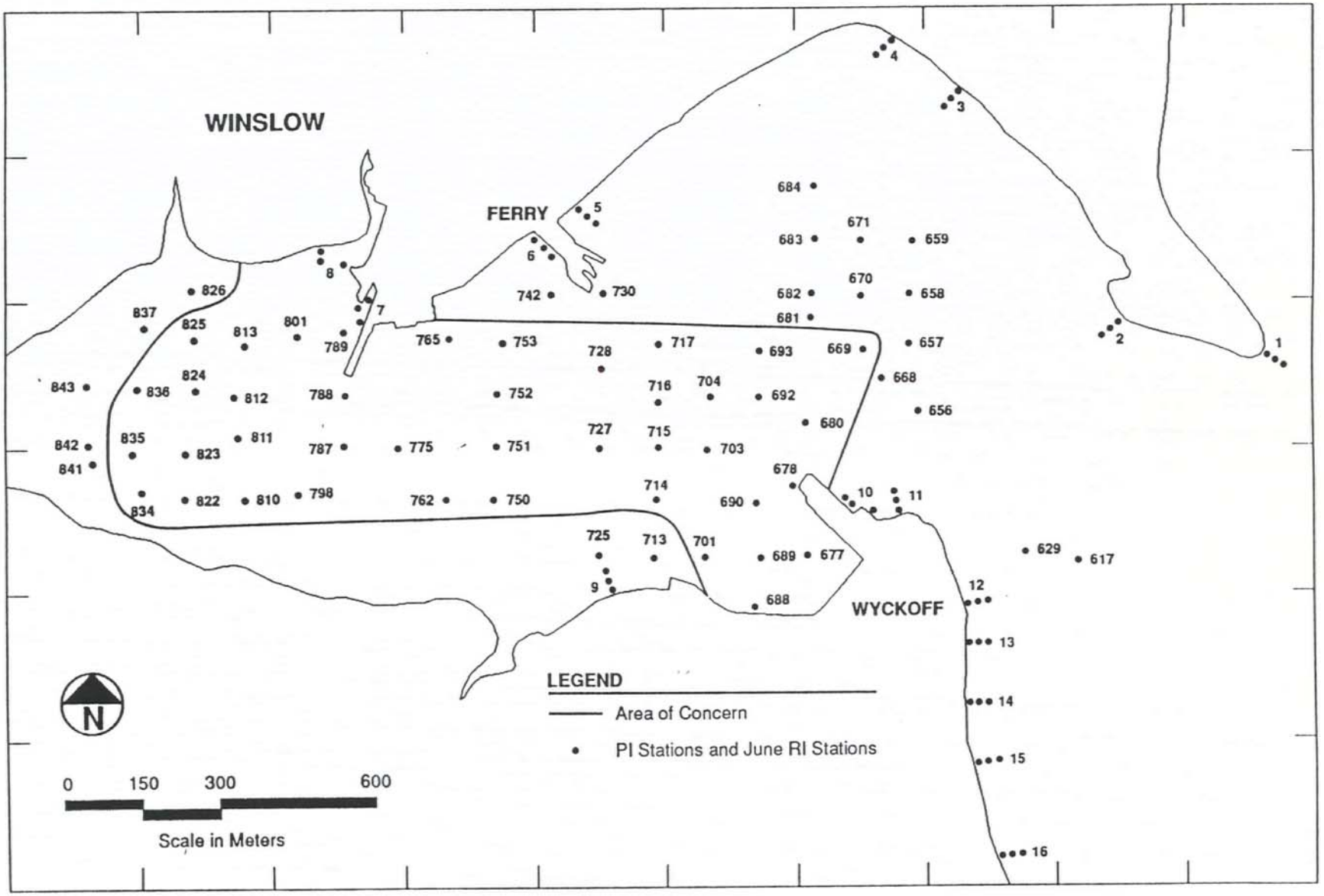


Figure 1-9
AREAS OF CONCERN OF MERCURY

3. Characterization of sedimentation rates, potential sources of fine sediments, and zones of sediment accretion and depletion within the harbor to support the evaluation of the no-action and capping alternatives

Supplemental site characterization activities required to provide data for the FS are as follows:

4. Source characterization of the Wyckoff facility:

   - o Horizontal and vertical distribution of contaminants in soil and groundwater, particularly deep groundwater
   - o Further characterization of the hydrogeology beneath the Wyckoff facility and adjacent subtidal areas

5. More detailed information on horizontal distribution of PAH in subtidal sediment in the vicinity of the central harbor hot spot and around the west dock of the Wyckoff facility

6. Characterization of the subsurface geology and hydrology of the central harbor by means of geophysical techniques and a groundwater flux zone investigation to evaluate the presence of geologic strata that can serve as a channel for contaminant flow to the harbor

7. Investigation of the deeper vertical distribution (to 20 feet) of sediment types and levels of contamination in the central harbor for the purpose of (1) estimating vertical extent of PAH in the most contaminated areas of the harbor; (2) investigating possible long-term sources of PAH which mich influence effectiveness of remedial alternatives; and (3) evaluating geologic properties that could influence PAH transport from known upland sources (Wyckoff facility soils) to Eagle Harbor sediments

8. Source characterization of the north shore shipyard area for the purpose of determining if soils are contaminated and if they could be an ongoing source of metals or PAH

FEASIBILITY STUDY PURPOSE AND APPROACH

The overall objective of the FS is to develop and evaluate appropriate remedial alternative strategies for correcting short- and long-term public health and environmental hazards that may be associated with contaminated sediments in Eagle Harbor. In an effort to proceed toward site remediation in

a timely manner, selected components of the remedial alternative development and evaluation will begin immediately. In order to do so, some assumptions will be made based on information currently available regarding potential sources and nature and extent of contamination. Following are the major assumptions to be used during this feasibility study:

- The central harbor does not have a continuous source of PAH contamination
- Alternatives will be evaluated based on a range of order-of-magnitude volumes and areas requiring remediation. Two scenarios will be evaluated, a high volume and area and a low volume and area
- Detailed volume and area estimates will be calculated during remedial design following the record of decision (ROD)
- No source control alternatives will be evaluated

Should the FS tasks indicate upland source control is required prior to harbor sediment remediation, an implementation strategy will be proposed. EPA will use the FS and the public comments on the FS to select an alternative for implementation. The selected remedial alternative will be issued by EPA as a ROD.

The FS will be developed according to the most recent EPA guidance documents, including the National Oil and Hazardous Substances Contingency Plan (NCP, 40 CFR Part 30, December 21, 1988; proposed rule), and in accordance with the 1986 Superfund Amendments Reauthorization Act (SARA). Specific guidance is provided by Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA, 1988). The specific elements of the FS approach are as follows.

1. Establish remedial action goals, including the long-term sediment cleanup levels, to protect human health and to protect the environment of Eagle Harbor and adjacent Puget Sound
2. Identify significant sources of sediment contamination and estimate, to the extent possible, the magnitude and duration of the release of contaminants into the harbor
3. Develop general response actions for sediment remediation in the harbor
4. Identify potential technologies that are applicable for sediment remediation (containment, treatment, or removal); screen the assembled technologies on the basis of key screening criteria (e.g., feasibility, proven versus nonproven) for each technology.

5. Reevaluate data requirements for the FS and determine if additional site characterization or treatability studies are needed; if necessary, conduct sampling and pilot tests and reevaluate the previous four steps

6. Select representative processes for appropriate technology types by evaluating process options on the basis of effectiveness, implementability, and relative cost

7. Assemble combinations of technologies into alternatives that provide a range of sitewide remediation and conduct a preliminary screening of the alternatives on the basis of implementability, effectiveness, and cost

8. Develop the screened alternatives to allow for a detailed evaluation (including the no-action alternative) on the basis of the following criteria specified in the NCP:

    - o Effectiveness
        - Overall protection of human health and the environment
        - Compliance with Applicable or Relative and Appropriate Requirements (ARARs)
        - Long-term effectiveness and permanence
        - Reduction in toxicity, mobility, and volume through treatment
        - Short-term effectiveness
    - o Implementability
    - o Cost (order-of-magnitude)
    - o State acceptance
    - o Community acceptance

The schedule developed for completion of this FS is presented in Section 3. As shown, is is considered to be an ambitious schedule set to accomplish the remedial alternative evaluation for Eagle Harbor sediments within as short a time as possible. This schedule will not be met if there is a scope expansion of this FS. Should the field tasks included in this work plan indicate the assumptions discussed above are not correct, EPA may need to reevaluate the recommended remedial action(s), and the FS schedule may need to be modified.

Section 2
SCOPE OF WORK

The feasibility study for the Wyckoff/Eagle Harbor site will be conducted following the intent of the NCP and in accordance with the 1986 Superfund Amendments Reauthorization Act (SARA). The following sections describe the required scope of work and present the proposed project deliverables.

The two-letter code (e.g., PM, FP) for each REM IV standard task is shown in parentheses following the task title. REM IV project management reports are organized by these task codes.

The separate tasks of the FS are listed in Table 2-1 and described in this section.

PROJECT PLANNING

TASK 1: WORK PLAN (WP)

The preparation of two drafts and this final FS work plan is covered by this task. A preliminary outline of the FS work plan was submitted on March 20, 1989. The first draft was submitted in April to EPA and the Eagle Harbor Technical Discussion Group (TDG) for review.

TASK 2: SOURCE IDENTIFICATION (ED)

On the basis of previous studies and findings of the RI, industrial activities conducted at the present location of the Wyckoff facility are believed to be the probable source of PAH contamination along the intertidal zone next to the Wyckoff facility and in the area north of the Wyckoff log rafting area. The source of the inorganic contamination reported in the sediments off the north shore shipyard is probably the sandblasting of marine antifouling paints that occurred during the 1940s to 1960s.

The source of the high concentrations of PAH reported in the central harbor area has not been determined with the available data. The primary focus at this time is to identify if the source was a past spill or if an ongoing source may exist. If there is an ongoing source, the alternatives evaluation in this FS will be affected.

The purpose of this task is to clarify the sources of PAH and metals in the harbor and evaluate if releases are continuing.

Table 2-1
SUMMARY OF WYCKOFF/EAGLE HARBOR FS TASKS

Task	Purpose
Project Planning	
1. Work Plan (WP)	Plan FS and describe scope, budget, and schedule.
2. Source Identification (ED)	Develop a more detailed source identification summary by evaluating historical activities and chemical fingerprinting data.
3. QAPP/FSP and SSP (QS)	Detailed data collection and quality assurance plans for field studies.
Sampling and Analysis	
4. Wyckoff Source Characterization (FT)	Conduct additional hydrogeologic investigations to: characterize stratigraphy of the site to a maximum of 200 feet; investigate presence of a dense phase of creosote; evaluate need for source control measures for "sinking product"; and prepare field memorandums and technical memorandums following data evaluation.
5. Diver Survey and Sediment Sampling (F1)	Evaluate horizontal extent of visually contaminated sediment around EH-08 and Wyckoff facility; correlate visual contamination with TPAH; estimate potential for near-surface upper 2 feet of sediment flow of dense phase PAH from the Wyckoff facility to the Central Harbor.
6. Subsurface Geophysics and Hydrologic Characterization (FP)	Map geologic features and areas of freshwater intrusion beneath harbor to assess potential areas of subtidal contamination seeps.
7. Deep Sediment Samples Impact Corer (F2)	Determine vertical extent of PAH contamination to a depth of 20 feet and investigate a geologic boundary in selected subtidal areas.

Table 2-1
(continued)

Task	Purpose
8. North Shore Shipyard Area Source Characterization (F3)	Evaluate new data collected by DOT; collect and analyze confirmation soil samples if needed.
9. Field Work Support (FK)	Provide administrative and office support to field investigation efforts; dispose of RI-derived wastes; prepare field memorandum for Tasks 5 through 8.
10. Laboratory Analyses (FC)	Analyze sediment and soil samples for TPAH by UV spectrophotometer and for interstitial salinity by optical refractometer.
Data Analysis	
11. Data Validation (DV)	Validate all laboratory data; prepare quality assurance reports.
12. Sedimentation Rate Evaluation (MD)	Assess Eagle Harbor sedimentation rates and identify areas of sediment accumulation and depletion.
13. Data Evaluation (DE)	Compile and evaluate data collected during Tasks 5 through 8.
Remedial Alternatives Screening and Evaluation	
14. Alternatives Identification/Technology Screening (AT)	Provide preliminary screening of technologies and identify treatability studies/pilot tests required; early development of alternatives.
15. Treatability Study/Pilot Testing (PT) (optional)	If needed, conduct treatability studies or pilot tests in order to adequately evaluate remedial action alternatives.
16. Alternatives Development and Screening (AD)	Assemble and define alternatives and conduct preliminary screening of alternatives for detailed evaluation.

Table 2-1
(continued)

Task	Purpose
17. Alternatives Evaluation (AE)	Prepare conceptual design of alternatives and evaluate based on NCP criteria; compare alternatives so that EPA can select recommended remedial action.
Feasibility Study Reports	
18. FS Report Preparation (R4)	Synthesize RI results and include with RI/FS task results in several draft reports; incorporate agency and public comments into a final RI/FS report.
Miscellaneous Support	
19. Project Management (PM)	Provide project, staff, and cost tracking and coordination and take responsibility for conducting FS in accordance with agreed work plan; coordinate with EPA.
20. Quality Control (QC)	Provide quality control checks on all deliverable documents and internal technical guidance.
21. External Meetings (MG)	Meet with EPA to review project milestones and with the Technical Discussion Group to disseminate FS information.
22. Community Relations (CR)	Assist EPA in updating and refining the existing community relations plan and assist in conducting two public meetings.

This task consists of three components: (1) preliminary PAH-source characterization based on a chemical fingerprinting analysis; (2) a review and consolidation of currently available information on past industrial activities; and (3) revised source characterization based on the data evaluation described in Task 4: Wyckoff Source Characterization, and, Task 8: North Shore Shipyard Area Source Characterization.

Fingerprinting techniques will be used to evaluate potential sources of PAH contamination reported in the RI. There are three sets of additional data for the proposed fingerprinting analysis:

- HPLC analysis of five soil and sludge samples taken from locations on the Wyckoff facility to provide contamination profiles for potential upland sources of PAH and NCAC

- Reanalysis of the chromatographs of all 35 confirmatory sediment samples to quantify the tentatively identified compounds (TICs), particularly the nitrogen containing aromatic compounds (NCACs) generally found in creosote and aliphatics generally found in fuel oils

- Reanalysis of selected Eagle Harbor sediment sample extracts for PAH and NCAC by EMSL-Las Vegas laboratory personnel, who specialize in source fingerprinting

The relative contribution of organic and inorganic contaminants from a typical watershed with characteristics similar to the Eagle Harbor watershed will also be estimated. A potential method is the approach that Metro (Municipality of Metropolitan Seattle) used in its watershed studies that correlates stormwater quality with the mixture of land use in a watershed of a given size and topography.

This task will generate a preliminary technical memorandum on source identification following receipt and validation of reanalysis data. The technical memorandum will include the following:

- A description of past and current potential sources of PAH and metals, including location, practices, source of chemicals used in process, and time period

- An estimate of the range of PAH and metals that would be expected from residential and nonlisted commercial activities (e.g., gas stations, parking lots, auto repair shops, and streets)

- An evaluation of the organic constituents of contaminated sediment, soil, creosote, and petroleum products so that the parent material (i.e., the source) of intertidal and subtidal contaminants can be estimated

- A list of assumptions used in the source fingerprint evaluation and uncertainties of the analysis

While conducting this preliminary source evaluation, the supplemental site and source characterization tasks (Tasks 4 and 8) will be ongoing. To develop and evaluate alternatives in a timely manner, some preliminary assumptions regarding the potential of ongoing contaminant sources will be made using the results of the diver survey, Task 4 geologic and visual field observations, and Task 8 DOT data review. An updated technical memorandum regarding potential source identification will be submitted following finalization of Task 4 and Task 8 field activities. This memorandum will contain an updated characterization of sources and the resulting assumptions that will be used during preliminary alternatives development and evaluation.

Following the completion of analytical data evaluation of soil and groundwater samples collected during field investigations, Task 2 will be completed. Alternatives development and evaluation will be finalized following completion of this data evaluation.

TASK 3: QAPP/FSP AND SSP (QS)

Five amendments to the Eagle Harbor RI Quality Assurance Project Plan and Field Sampling Plan (QAPP/FSP) and the Site Safety Plan (SSP) will be developed to support the sampling and analysis tasks described in this FS. The purpose of the QAPP/FSP amendments is to establish data quality objectives, specific QA/QC objectives and criteria for each of the field activities and laboratory analyses, and to describe specific field sampling procedures. The QAPP/FSP amendments are listed below:

Amendment No.		
2	Task 5:	Diver Survey and Sediment Sampling (F1)
3	Task 6:	Subsurface Geophysics and Hydrologic Characterization (FP)

4 Task 7: Deep Sediment Characterization (F2)

5 Task 8: North Shore Shipyard Area Source Characterization (F3)

6 Task 4: Wyckoff Source Characterization (FT)

Costs for developing the QAPP/FSP and SSP amendment for Task 4 will be tracked through a separate project budget for cost recovery purposes.

SAMPLING AND ANALYSIS

The details of the sampling and analysis tasks will be developed in the QAPP/FSP amendments. For this work plan, the tasks were developed in enough detail to estimate approximate labor, expense, and subcontractor costs. General descriptions of each task are listed below. The preliminary estimate of the number of samples and analyses for the field tasks are presented in Table 2-2.

TASK 4: WYCKOFF SOURCE CHARACTERIZATION (FT)

Introduction

On the basis of visual observations, the intertidal area around the Wyckoff facility continues to be a discharge zone of immiscible product. As discussed in the RI report, creosote releases to the harbor may occur as three separate phases: a floating phase, a dissolved phase, and a sinking phase. The sinking phase or dense nonaqueous phase liquid (DNAPL) may be discharging in the deeper subtidal areas or remain in the sediments, likely spreading out in fingers above a low permeability layer. Previous subsurface investigations at the Wyckoff facility have not focused on the nature or extent of DNAPL.

Purpose

The purpose of Task 4 is to determine if subsurface DNAPL transport is occurring from the Wyckoff facility to the subsurface sediments of Eagle Harbor. The following items will be addressed:

- Hydrostratigraphy of the site at depth (not to exceed 200 feet
- The presence of dissolved phase constituents
- Vertical and horizontal extent of sinking product beneath the Wyckoff site

Table 2-2
ASSUMED NUMBER OF SAMPLES AND ANALYSES

Task	Number of Stations	Number of Duplicate Stations	Number of Samples	Field Screen[a]	HPLC PAH	Refractometer Salinity	NCACs	Stored Samples	Other
4 Wyckoff Source Characterization Upland Hydrogeology	11	2	520	260	20	0	--	520	25[b], 6[c]
5 Diver Survey and Sediment Sampling (F1)	92	8	80	80	20	--	--	80	--
7 Deep Sediment Samples Impact Corer (F2)	18	2	440	440	34	440	44	440	80[b], 10[c]
8 Shipyard Source Characterization (F3)	To be determined								

[a] UV spectrophotometer.

[b] Physical parameters.

[c] SAS GC/MS.

- Vertical and horizontal hydraulic gradients in zones which potentially contain DNAPL
- Groundwater quality in zones that potentially contain DNAPL
- Potential migration pathways of sinking product from Wyckoff site to Eagle Harbor

Task 4 is necessary to determine if source control is needed prior to remediating Eagle Harbor sediments. The investigation does not constitute a comprehensive remedial investigation (RI) of the Wyckoff site. Also, this proposed study is distinct from the ongoing Expedited Response Action (ERA) at the Wyckoff facility, which is focusing on recovery of floating product and groundwater treatment.

Approach

Hydrogeologic data will be collected by installing up to 11 monitoring wells (six initial and five optional). The total borehole depth and location of the screened intervals will be determined by the field hydrologist.

For costing purposes it has been assumed that the subsurface investigation will extend to a maximum depth of 200 feet. This depth is somewhat arbitrary because of the lack of hydrostratigraphic data below 70 feet. It is anticipated that most borings and wells will not exceed 125 feet in depth.

During drilling of the initial six monitoring well boreholes, subsurface samples will be collected for the following:

- Visual and olfactory observation
- Field laboratory contaminant screening
- Contract laboratory analyses
- Physical properties testing

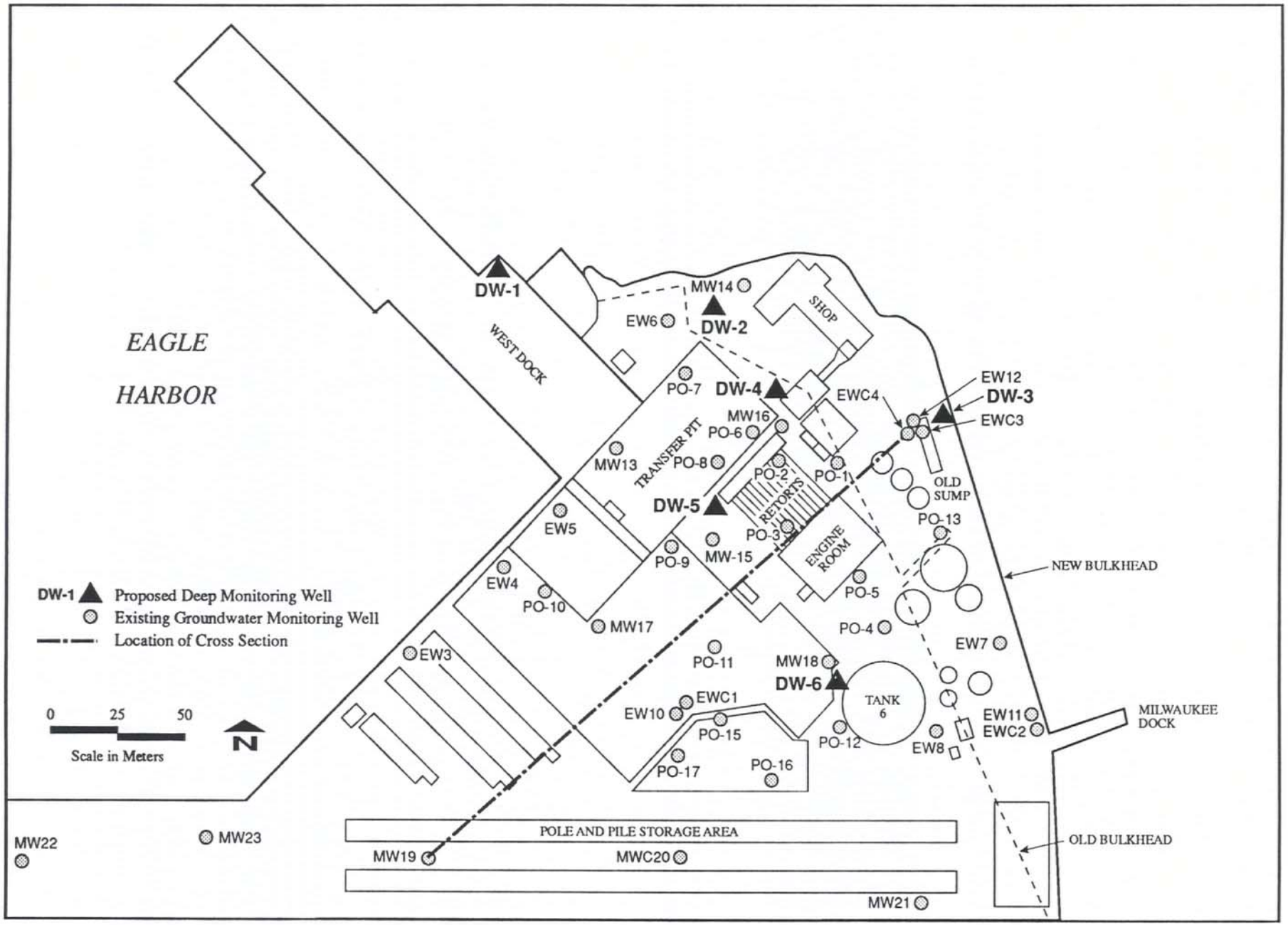
Following a review of information gained from the first six monitoring wells, the scope of the investigation will be reviewed and modified as needed before installing the remaining monitoring wells. These optional five monitoring well or borehole locations, rationales, methods and procedures will be specified in an amendment to the workplan.

Borehole and Monitoring Well Locations and Rationales

Tentative locations for the first six monitoring wells are indicated in Figure 2-1.

Monitoring well location rationales are summarized as follows:

- DW-1 is located at West Dock in the intertidal zone
- DW-2 is located near the Eagle Harbor shoreline near a suspected migration pathway of immiscible product
- DW-3 is adjacent to a former sump area that is a suspected source area of DNAPL
- DW-4 and DW-5 are located near the retort area, which is a suspected source of DNAPL
- DW-6 is located near Tank 6, which is a suspected source of DNAPL



NOTE: Existing groundwater station locations from Entrix, 1986, Tetra Tech, 1987 and AGI, 1989.

Figure 2-1
LOCATIONS OF PROPOSED MONITORING WELLS

Drilling Methods and Procedures

Boreholes will be drilled using the cable tool drilling method. Each boring will be advanced to total depth with a temporary steel casing following the standard drill drive sequence. Telescoped casing will be used to minimize the possibility of the migration of nonaqueous liquid or dissolved contaminants from the upper contaminated zones to lower zones.

The depths at which the casing will be telescoped will be determined by the project hydrogeologist on the basis of the following information:

- Observation of soil samples for visible indication of contamination
- Results of the onsite field laboratory analyses for TPAH
- Presence of a relatively low permeability layer that appears to be of significant thickness and lateral extent

Details of the telescoping criteria, methods, and procedures will be discussed in the Field Sampling Plan (FSP). For costing purposes, it is assumed that the drilling casing will be telescoped once.

Soil Sampling and Analyses

During drilling, soil samples will be collected at 5-foot intervals using a split spoon or Dames and Moore sampler for field geological classification and analysis by the onsite laboratory for TPAH. The onsite laboratory will consist of a UV spectrophotometer that has a detection limit of 10,000 mg/kg for TPAH. A minimum of two relatively undisturbed sample from each borehole will be collected for grain size analysis and for permeability testing. Sample selection criteria will be discussed in the FSP. Approximately 10 percent of the samples collected for onsite field laboratory analysis of TPAH will be analyzed for priority pollutant PAH by HPLC through the CLP according to the method detailed in the RI QAPP/FSP (CH2M HILL, 1988). Finally, one sample from each interval will be archived for potential future analysis.

Monitoring Well Construction and Development

Monitoring wells will be constructed in accordance with WAC 173-160. Bentonite seals will be installed to prevent vertical migration of groundwater after drilling is completed. Monitoring well materials will consist of 4-inch

stainless steel sump, screen and riser. Following installation, monitoring wells will be developed by surging and bailing.

Aquifer Testing

Each well will be pumped for up to 4 hours. Aquifer transmissivities will be estimated from water-level drawdown and recovery data. Transmissivities will be estimated using the Theis or Jacob drawdown method and/or the Theis recovery method.

Groundwater Monitoring

Approximately 3 weeks after well development, the new monitoring wells will be sampled and the water analyzed for PAH by GC/MS in accordance with CLP protocol. Concurrently, static water levels will be monitored in the new wells, selected adjacent shallow wells, and a stilling well at the west dock with electronic transducers and data loggers for a period of one week for the purpose of investigating tidally influenced hydraulic gradients.

Deliverables

The deliverables associated with Task 4 include:

- QAPP/FSP and SSP Amendment No. 6
- Field Memorandum
- Quality Assurance Report
- Technical Memorandum

The Task 4 technical memorandum will include the following items:

- Geologic logs of all boreholes
- Hydrostratigraphic cross sections
- Hydrographs for deep wells and a subset of the shallow wells
- Vertical and horizontal groundwater gradient analysis
- Soil screening for TPAH with a minimum of 50 percent of the soil samples taken and confirmatory HPLC data for approximately 10 percent of the screened samples
- Physical parameter soil test results for permeability and grain-size analysis

- Aquifer testing results
- Water quality data for the new monitoring wells
- Extent of visible contamination of TPAH
- Evaluation of potential offsite DNAPL migration

The Task 4 results will be used to finalize the source identification technical memorandum (Task 2). Task 2 will identify the need to pursue additional source control action, especially DNAPL control, prior to permanent harbor sediment remedial actions.

TASK 5: DIVER SURVEY AND SEDIMENT SAMPLING (F1)

The purpose of this task is to delineate the horizontal and, if possible, vertical extent of the central harbor hot spot. A secondary objective is to sample transects between Wyckoff and the central harbor hot spot to determine if visible contamination is continuous in the near-surface sediment between the Wyckoff intertidal seeps and the hot spot.

Sediment will be collected from approximately 100 stations by a hand-held coring device that is expected to sample up to a depth of 2 feet (60 cm). Table 2-3 summarizes the number of sediment samples to be collected along the transects. Figure 2-2 diagrams the proposed diver transects.

Table 2-3
DIVER TRANSECT LENGTH AND NUMBER OF STATIONS

Transect No.	Length (m)	Number of Stations	Number of Field Duplicates	Priority
1	100	4		Highest
2	100	4	1	2
3	100	4		3
4	100	4	1	4
5	100	4		5
6	100	4	1	6
7	400	16	1	8
8	400	16	1	9
9	400	16	1	7
10	300	12	1	10
11	200	8	1	11
Total	2,300	92	8	

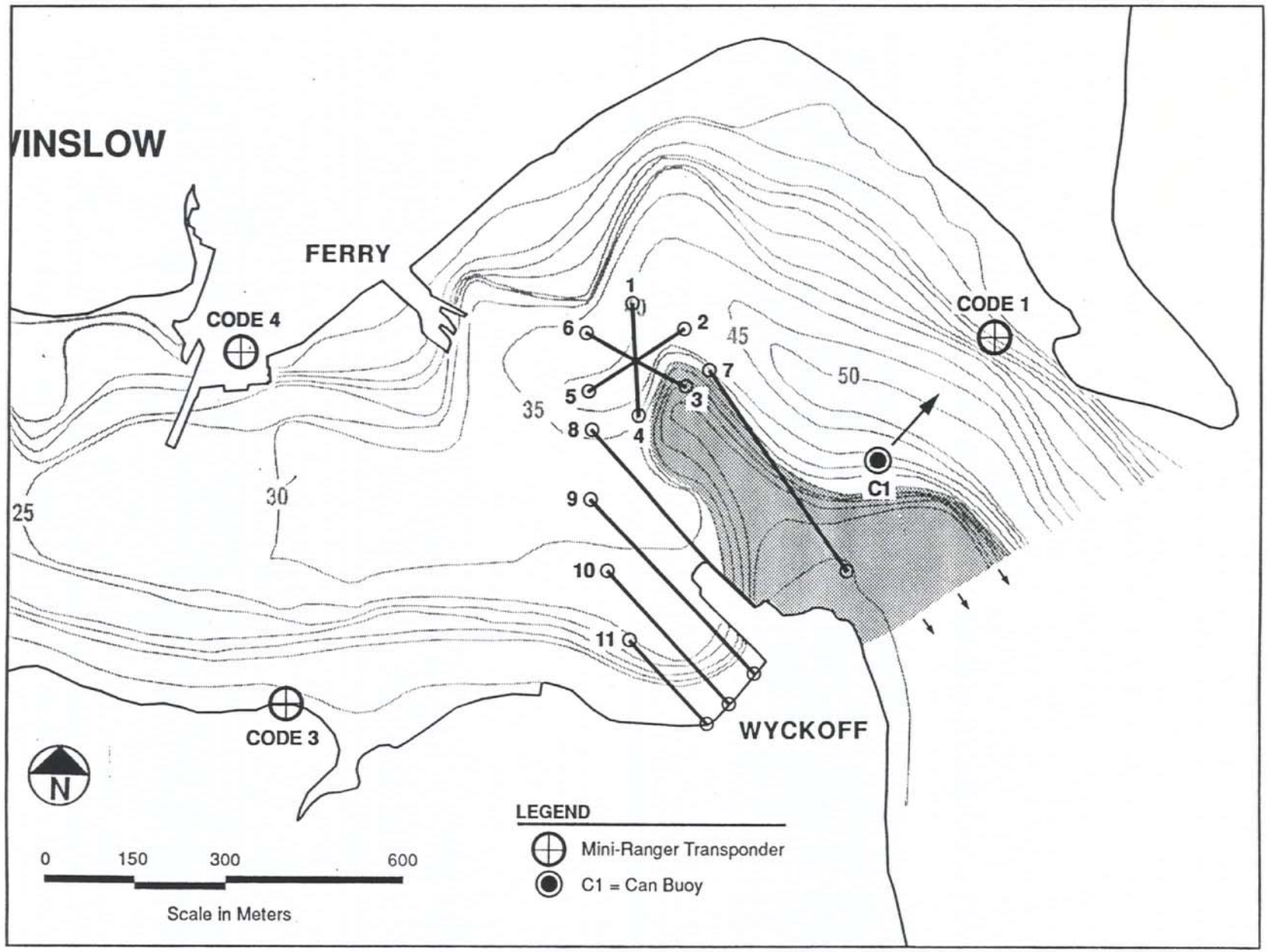


Figure 2-2
LOCATION OF DIVER TRANSECTS

Samples will be brought to the surface, extruded, photographed, sediment type noted, and presence of oily contamination noted within the core collected. Eighty sediment samples from 33 stations will be collected and screened for TPAH using a UV spectrophotometer.

Twenty of the 80 samples screened for TPAH will be selected for HPLC confirmatory analysis for PAH. The intent of this confirmatory analysis is to correlate screened concentration of TPAH with HPLC results to determine the variability in the screening analysis. These results will be used to determine the actual number of confirmatory sample analyses needed for the characterization of Wyckoff soil discussed in Task 4. The current assumption is that 10 percent of the screened samples will be adequate for confirmation.

The deliverables associated with Task 5 include:

- QAPP/FSP and SSP Amendment No. 2
- Field Memorandum
- Quality Assurance Report
- Technical Memorandum

The field memorandum will consist of the field logs, a summary of the visible contamination observed, and an evaluation of visible contamination compared to the screening level TPAH results. The results of the validation of CLP data will be presented in a quality assurance report under Task 11. The results will be interpreted and presented in a technical memorandum under Task 13.

TASK 6: SUBSURFACE GEOPHYSICS AND HYDROLOGIC CHARACTERIZATION (FP)

As discussed in the RI report, subsurface movement of dense nonaqueous phase creosote is a potential pathway from the Wyckoff facility into the subtidal sediments. The purpose of this task is to map geologic strata off the Wyckoff facility, do a preliminary evaluation of potential groundwater intrusion areas, and refine harbor bathymetry.

Subtask 6.1: Geophysical Survey

Geologic strata profiles can be determined by penetrating sonar. This is a common method of mapping geologic strata beneath marine sediments. A highly permeable channel, such as a gravel layer interbedded between compact sand and silt (i.e., a buried beach surface) could be detected by bottom profiling sonar if it is greater than about 30 cm in thickness and within about 6 meters of the sediment surface.

This subtask includes a geophysical investigation using a high-resolution sub-bottom sonar to profile the upper 6 meters

and a seismic reflection system for profiling to about 50 meters. Figure 2-3 diagrams the proposed scanning grid for this subtask.

CH2M HILL will be responsible for navigational positioning; EPA will provide a boat (the RV Monarch) and boat operator; and a subcontractor will do the geophysical scanning and interpretation. Fathometer readings during transects will be used to refine existing harbor bathymetry information, especially in the area of the shoal, west dock, and Wyckoff log rafting area.

Subtask 6.2: Subtidal Hydrologic Characterization

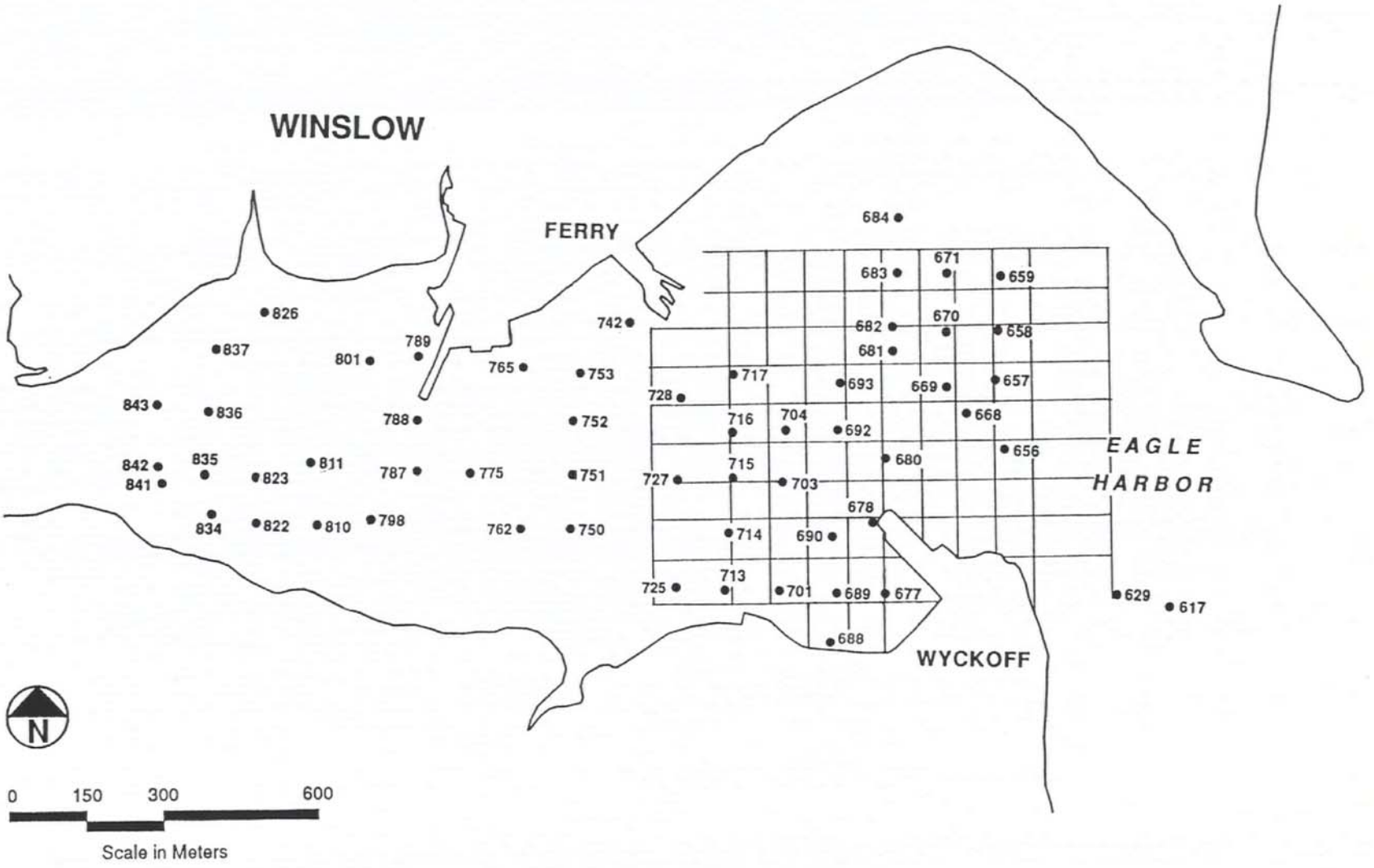
To supplement the subsurface geologic profiling, the subtidal surficial sediments will be surveyed using conductivity and temperature probes to directly detect freshwater intrusion zones. These probes, towed from a small boat, have direct contact with the bottom sediment and give a continuous record of bulk electrical conductivity and temperature. The sensor data will then be calibrated by using shallow temporary piezometers driven in the sediments from a boat or floating platform. It is assumed that five temporary piezometers will be needed.

TASK 7: DEEP SEDIMENT SAMPLES IMPACT CORER (F2)

An estimate of the vertical extent and profile distribution of PAH contamination as well as geologic strata in the subtidal sediments is needed to adequately evaluate remedial alternatives, especially for in situ containment and removal options. The sediment depths evaluated thus far for PAH contamination have primarily ranged from zero to about 30 cm in the subtidal areas. Sediment at EH-08 has been analyzed to a depth of 50 cm. The depth distribution of PAH concentrations varied considerably in these studies. Sample cores were reported to have increased concentrations with depth, while in others, concentrations decreased with depth. Some cores showed a mid-depth stratum of high concentrations while others showed relatively uniform contamination throughout the depths sampled. Several stations with high PAH concentrations (EH-08, EH-682, EH-703, and EH-788) were among those stations that showed some increase in PAH concentration with depth.

The increased concentration with depth could be due to a deposit of clean sediment over older contaminated sediments, infiltration of the denser PAH from the surface sediments, and/or subsurface transport (i.e., subtidal seeps).

In order to clarify the available information regarding depth of PAH contamination, especially in areas of most interest



North-South Transects - 150 Meter Interval
East-West Transect - 60 Meter Interval

Figure 2-3
APPROXIMATE GEOPHYSICAL TRANSECT LOCATIONS

to remedial action alternatives, a deep-core sediment sampling program is proposed.

Objectives for the deep-core sampling are:

- To determine the vertical distribution of PAH
- To note geologic strata, particularly confining layers that may be linked to upland geologic boundaries
- To evaluate interstitial salinity to confirm Subtask 6.2 results
- To estimate the volume of contaminated sediment in the area most likely requiring remediation

The approximate locations of the 18 proposed deep-core sample stations are shown in Figure 2-4. Twelve of the locations were sampled during the RI, four stations (EH-8, RB-6, EH-16, and EH-1) were sampled during Tetra Tech's preliminary investigation (1986), and two stations are in previously unsampled locations.

An impact corer, which has a 6-meter (20-foot) sediment sampling depth, will be used to collect deeper sediment. The impact core sample will be split lengthwise down the middle, the stratigraphy noted, and a composite sample of specified depth intervals will be collected from the exposed center portion of the core and homogenized. The homogenate will be split into four aliquots: one for screening TPAH, one for interstitial salinity, and two for either confirmatory analyses or storage. TPAH will be analyzed by UV spectrophotometer and interstitial salinity by an optical refractometer.

Any samples below the 90-cm depth that have TPAH concentrations greater than 10,000 µg/kg, as analyzed by the UV spectrophotometer, will be analyzed for PAH by HPLC and NCAC. The two remaining aliquots for these samples will be sent to CLP and the Manchester laboratories for analysis of PAH and NCAC, respectively. Sample aliquots not needed for confirmatory analyses will be stored. For budgeting purposes, it is assumed that 440 samples (20 cores--18 stations plus field duplicates--times 20 depth intervals) will be analyzed for salinity and TPAH. It is assumed that 44 samples (10 percent) will be analyzed for PAH by HPLC.

Depth intervals to be sampled will generally be more frequent in the upper 5 feet of the core (10-cm interval) and less frequent in the lower 15 feet (100-cm interval). The field team leader (FTL) will maintain some flexibility to sample depth intervals of special interest based on visual field

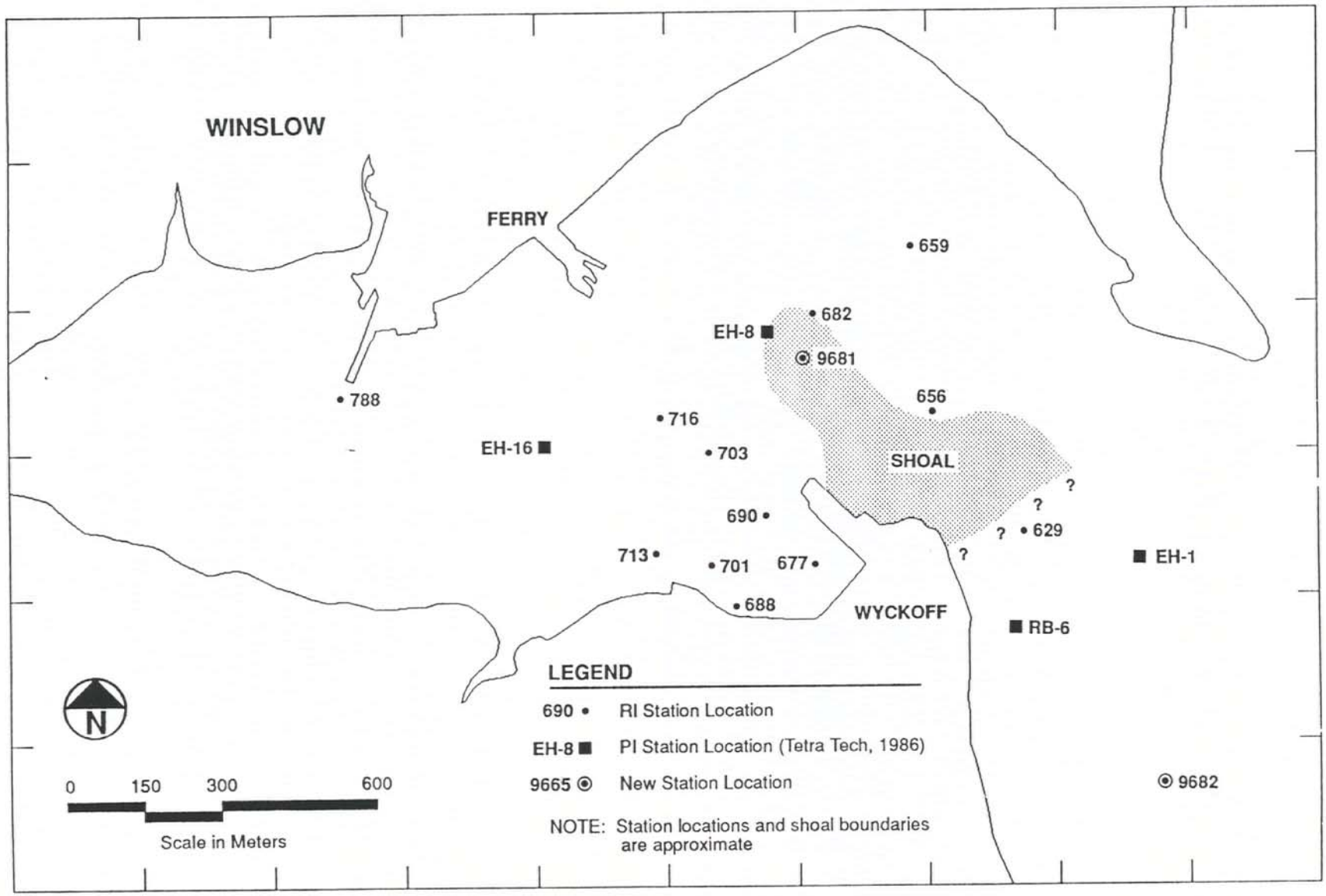


Figure 2-4
PROPOSED DEEP CORE SAMPLE LOCATIONS, EAGLE HARBOR

observations. Details of the criteria for determining depth intervals will be included in the QAPP/FSP amendment for this task. For cost estimating purposes, approximately 20 depth interval samples have been assumed per core.

TASK 8: NORTH SHORE SHIPYARD AREA SOURCE CHARACTERIZATION (F3)

Results of the public health risk assessment and ecological assessment in the RI indicate that PAH and metals are problem chemicals in the north shore shipyard area. DOT has recently analyzed surface sediment and soil (zero to 6 inches) in this area, focusing on the western portion of this industrial area. A preliminary verbal report of their analysis indicated elevated PAH and metals in this area (CH2M HILL, 1989b).

The purpose of this task is to evaluate the DOT data and confirm the DOT results, if needed, by minimal sampling. For costing purposes, it is assumed that five DOT stations will be resampled and analyzed for PAH by HPLC and metals.

The details of the sampling and analysis procedures will be completed following review of the DOT data report.

TASK 9: FIELD WORK SUPPORT (FK)

This task covers the cost of miscellaneous field support activities for all the field sampling tasks except Task 4, which will be tracked separately. The task includes equipment procurement, safety officer activities, sample handling, subcontractor procurement, sample documentation, and shipping; sample tracking from collection to receipt of data validation results; sample storage; and writing field memorandums for Tasks 5, 6, 7, and 8.

Management of sampling-derived wastes will also be covered by this task. It is not known if oil slicks will be caused by the deep coring. The sampling crew will be prepared to place a floating boom around the slick and collect the oil with absorbent pads. Waste collection and storage procedures will be incorporated in the sample collection planning and conducted in accordance with 40 CFR 261.4(d). The waste material will be properly contained and documented. An EPA official will sign the necessary manifests for shipping the waste to a disposal or treatment company.

TASK 10: LABORATORY ANALYSES (FC)

This task covers the cost of TPAH screening analysis and salinity determinations. It is assumed that a mobile laboratory will be used for the UV spectrophotometer screening analysis, and that the interstitial salinity measurements

will be done at the Ecology/EPA Manchester Laboratory. HPLC and GC/MS analyses and soil physical parameters will be done through the CLP laboratories.

DATA ANALYSIS

TASK 11: DATA VALIDATION (DV)

The analytical results will be validated using the same procedures as those in the validation of the RI data. A quality assurance report will be prepared for each sample delivery group and submitted to the EPA quality assurance manager (QAM) for review and approval. The validated data will be entered into the Eagle Harbor RI/FS data base, and electronic files will be submitted to EPA. The data will be listed in technical memoranda, which will include the relevant QA reports as appendixes.

TASK 12: SEDIMENTATION RATE EVALUATION (MD)

Estimates of sediment deposition rates are important in the evaluation of the no-action and capping alternatives. In some limited areas of the harbor where there is an adequate source of sediment and net sediment deposition, the natural capping of contaminated sediments may be adequate to protect the environment, although the recovery time is not known. The RI report includes a preliminary evaluation of sediment deposition rates. This task is a more detailed evaluation of the rate of deposition to determine the time frame of natural capping.

It also is important to know whether the new sediments are contaminated, so the sources of the sediments need to be estimated. Estimates of sedimentation rates and delineation of sediment accretion and depletion areas will help in the interpretation of historical versus current sources of contamination. The estimates of possible ongoing PAH contributions from various upland sources identified in Subtask 2.1 will be incorporated into this task. They will be used as a basis for assumptions related to depositional sediment quality.

The amount of material available for deposition will be roughly estimated in terms of possible ranges rather than attempting to quantify each component. The quantities of beach-derived material will be evaluated by using the alongshore transport model developed during the RI. This model will be extended to evaluate possible transport from the north. The amount of sediment that can be expected to enter the harbor from the watershed will be estimated on the basis of overall land use, soil type, and runoff. The estimate of the quantity of sediment entering the harbor from Puget

Sound will be based on available data. One of the existing harbor siltation models (e.g., the SEDCAM model used for the Commencement Bay FS) will be selected and used to determine how much suspended sediment can be expected to deposit in the harbor and how rapidly the sediments would recover, given certain assumptions regarding levels of source control.

TASK 13: DATA EVALUATION (DE)

This task includes evaluation, statistical analyses, graphical representation, and interpretation of the data. The preparation of technical memorandums for Tasks 5 through 8 is included in this task.

REMEDIAL ALTERNATIVES SCREENING AND EVALUATION

The approach to developing and screening remedial alternatives is described below. The three major tasks are:
Task 14: Alternatives Identification/Technology Screening;
Task 16: Alternatives Development and Screening; and
Task 17: Alternatives Evaluation. Task 15 (Treatability Study/Pilot Testing) is discussed in this section; however, this task is not yet scoped since it is contingent upon the results of Subtask 14.6, Reevaluation of Data Needs.

TASK 14: ALTERNATIVES IDENTIFICATION/TECHNOLOGY SCREENING (AT)

The objective of this task is to compile a list of potential remedial alternatives for Eagle Harbor sediment remediation by assembling combinations of screened technologies. This task will begin very early in the FS with a review of the technology screening and alternative identification process used at the Commencement Bay Superfund site (Tetra Tech, 1988). As applicable, the following steps will be taken:

- Determine remedial action objectives on the basis of the human health risk assessment and the ecological impact assessment presented in the RI report and the no-action alternative ARARs analyses
- Develop general response actions for specific areas or volumes of media to which containment, treatment, or removal actions may be applied
- Identify potential remedial technologies and prescreen on the basis of technical implementability
- Evaluate process options on the basis of effectiveness, institutional implementability, and

relative costs, to select (a) representative process technology(ies) for appropriate technology types

- Reevaluate data needs
- Assemble technologies into alternatives

Figure 2-5 diagrams the components of this task.

Subtask 14.1: ARARs Analyses

A preliminary ARARs analysis of the no-action alternatives will be conducted to guide this task and will be prepared as a separate technical memorandum for review. This ARARs analysis follows the procedures established in Section 121(d) of CERCLA for remediation of a hazardous substance site. Briefly, the ARARs analysis will identify the requirements of federal and state environmental and public health laws to be followed during remediation. In addition to promulgated laws, guidance levels, criteria, and other advisories suggested to protect public health and the environment also are "to be considered" (TBCs) during remediation.

ARARs and TBCs generally fall into three different categories:

- Chemical specific
- Location specific
- Action specific

The chemical-specific and location-specific ARARs and TBCs will be evaluated for the no-action alternative. The requirements to be reviewed for Eagle Harbor for these two categories are listed in Table 2-4.

Based on the RI public health risk assessment and ecological assessment, the areas under consideration for remedial action are:

- The sediment in the central harbor area, based on exceedances of the site-specific benthic apparent effects threshold (AET) for PAH
- The subtidal sediment in the vicinity of Wyckoff's log rafting area, based on exceedances of the site-specific benthic AET for PAH
- The intertidal sediment in the north shore shipyard area, based on exceedances of Ecology's AET for mercury
- The intertidal sediment at Wyckoff's facility, based on exceedances of site-specific AET for PAH

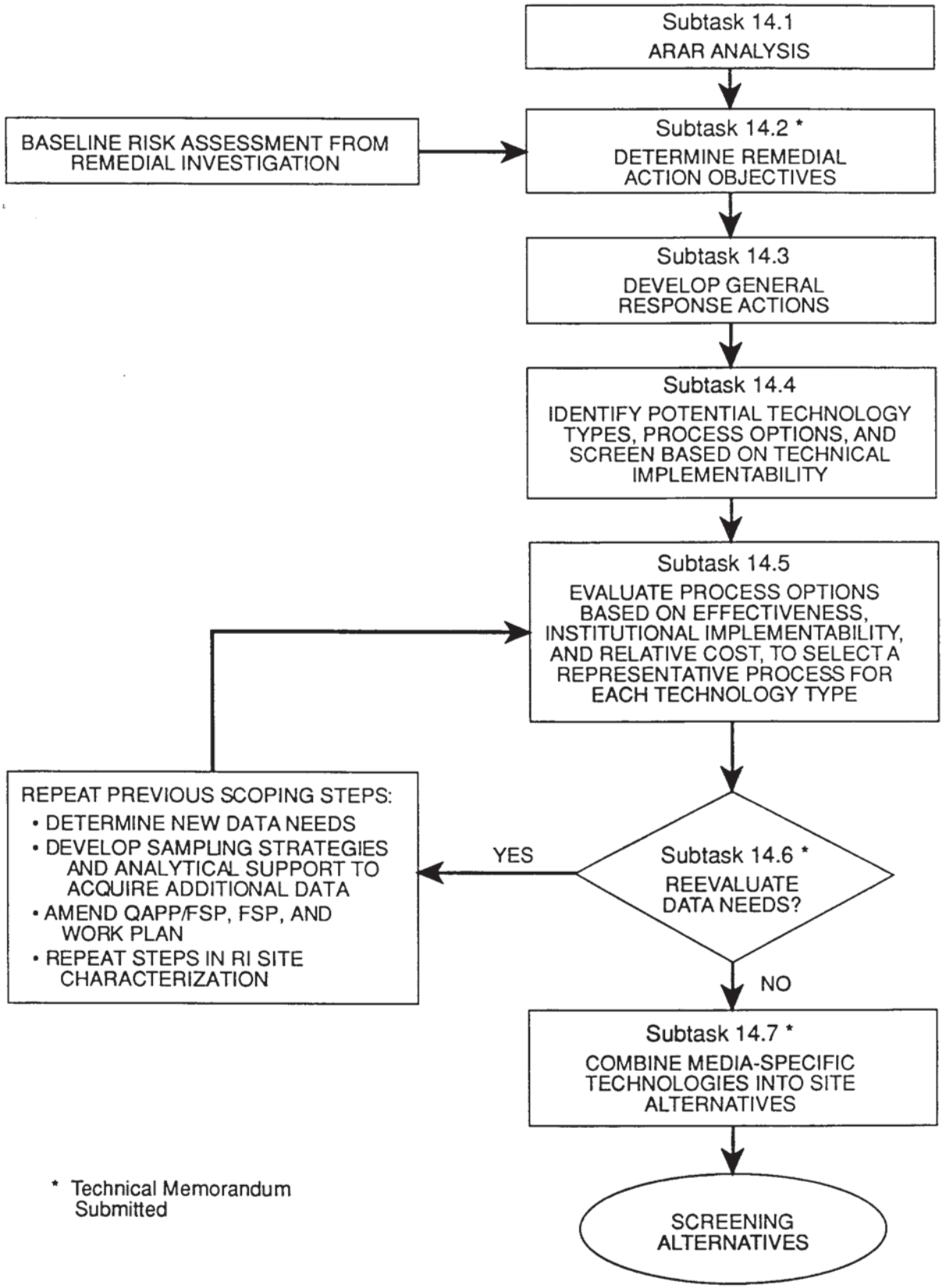


Figure 2-5
ALTERNATIVES IDENTIFICATION/ TECHNOLOGY SCREENING

Table 2-4
FEDERAL AND STATE REQUIREMENTS REVIEWED IN THE
IDENTIFICATION OF CHEMICAL- AND LOCATION-SPECIFIC ARARS

FEDERAL

Clean Water Act
Coastal Barrier Resources Act
Coastal Zone Management Act
Endangered Species Act
Executive Order on the Protection of Flood Plains
Executive Order on the Protection of Wetlands
Fish and Wildlife Coordination Act
Marine Protection Resources and Sanctuary Act
National Archaeological and Historic Preservation Act
National Historic Preservation Act
Protection of Flood Plains
Resource Conservation Act
Safe Drinking Water Act
Wild and Scenic Rivers Act
Wilderness Act

STATE OF WASHINGTON

Public Water Supplies Primary and Secondary Maximum Contaminant Levels
Water Quality Standards for Surface Water

TBC

Proposed Groundwater Quality Standards
Proposed Sediment Quality Standards
Puget Sound Dredged Disposal Analysis Criteria

Subtask 14.2: Development of Remedial Action Objectives

Remedial action objectives (RAO) are media-specific goals for protecting human health and the environment, which are developed by taking into account contaminants, media of interest, and exposure pathways. These general objectives are based on chemical-specific ARARs, estimated acceptable risks to public health, and protection of environmental resources. Evaluation of these objectives are based on the following RI results: nature and extent of contaminants, the public health risk assessment, and the environmental impact assessment. These RI results will be combined with the FS no-action chemical-specific ARARs analysis as described above.

The RI results related to these objectives are:

- Estimated public health excess cancer risks, based on ingestion of intertidal sediments and shellfish, are in the $1_{-4} \times 10^{-6}$ (average exposure scenarios) to 4×10^{-4} (maximum exposure) range. These estimated risks are 2 to 10 times higher than estimated risks from exposure to background concentrations in Puget Sound.

- These risks may be higher due to the dermal exposure pathway; however, there is unacceptable uncertainty in quantitatively estimating the risk associated with this pathway.

- Central harbor water quality data and fish tissue data do not currently indicate a public health risk related to ingestion of Eagle Harbor fish; however, data are not available to evaluate the potential for risks to bioconcentrated mercury.

- Benthic animals are noticably absent from some intertidal areas near the Wyckoff facility and near the north shore shipyard area.

- Bioassay results indicated toxic conditions occur in subtidal sediments especially in the central harbor "hot spot" and in the Wyckoff log storage area.

- PAH in sediment from Eagle Harbor have been shown to cause tumors and lesions in some fish and a suppression of ovarian development in English sole.

For purposes of this FS, remedial action objectives are focused on meeting ARARs and protecting public health and environmental quality in Eagle Harbor, including the intertidal area at the Wyckoff facility. The upland portion of the Wyckoff facility is not included in this RAO development task.

Subtask 14.3: Development of General Response Actions

For each medium of interest (intertidal sediments and subtidal sediments), general response actions will be developed to satisfy the remedial action objectives. General response actions will not be developed for contaminated groundwater and soils at the Wyckoff facility since it will be addressed as part of an RI/FS for the Wyckoff operable unit.

A final determination will be made of areas or volumes of sediment to which general response actions might be applied following completion of the field tasks planned during this FS. Consideration will be given to acceptable contaminant levels, exposure routes, site conditions, and the nature of the contamination in developing the general response actions. Preliminary general response actions for sediments are listed below:

- No Action/Natural Recovery
- Institutional Controls
- Containment
- Dredging to Remove Contaminated Sediments
- Treatment of Excavated Materials
- Disposal of Excavated Materials

Subtask 14.4: Identification and Screening of Potential Remedial Technologies and Process Options

Based on the general response actions and review of similar studies, such as the Commencement Bay FS, a table of potential technology types and process options to achieve remedial objectives will be compiled. Technology screening for the Eagle Harbor site will be based on engineering judgment, effectiveness, and if needed, present worth cost. Criteria that will be used include:

- Site conditions that may limit or promote the use of certain technology types and process options

- Waste characteristics that may limit the effectiveness or feasibility of certain technologies

Technologies that are not applicable will be eliminated from further consideration.

Subtask 14.5: Evaluation of Process Options

Process options will be evaluated regarding effectiveness, implementability, and cost in order to select a representative process option for each of the screened technology types.

- Effectiveness will be evaluated according to:
  - Ability to handle the volumes and meet remedial action objectives
  - Level of protection of human health and the environment during construction
  - Whether the process is a proven, reliable technology

  If additional site data or preliminary analyses to assess effectiveness are needed at this stage, including a limited design of the process or environmental response monitoring, a work plan amendment will be prepared, as discussed below under Subtask 14.6.

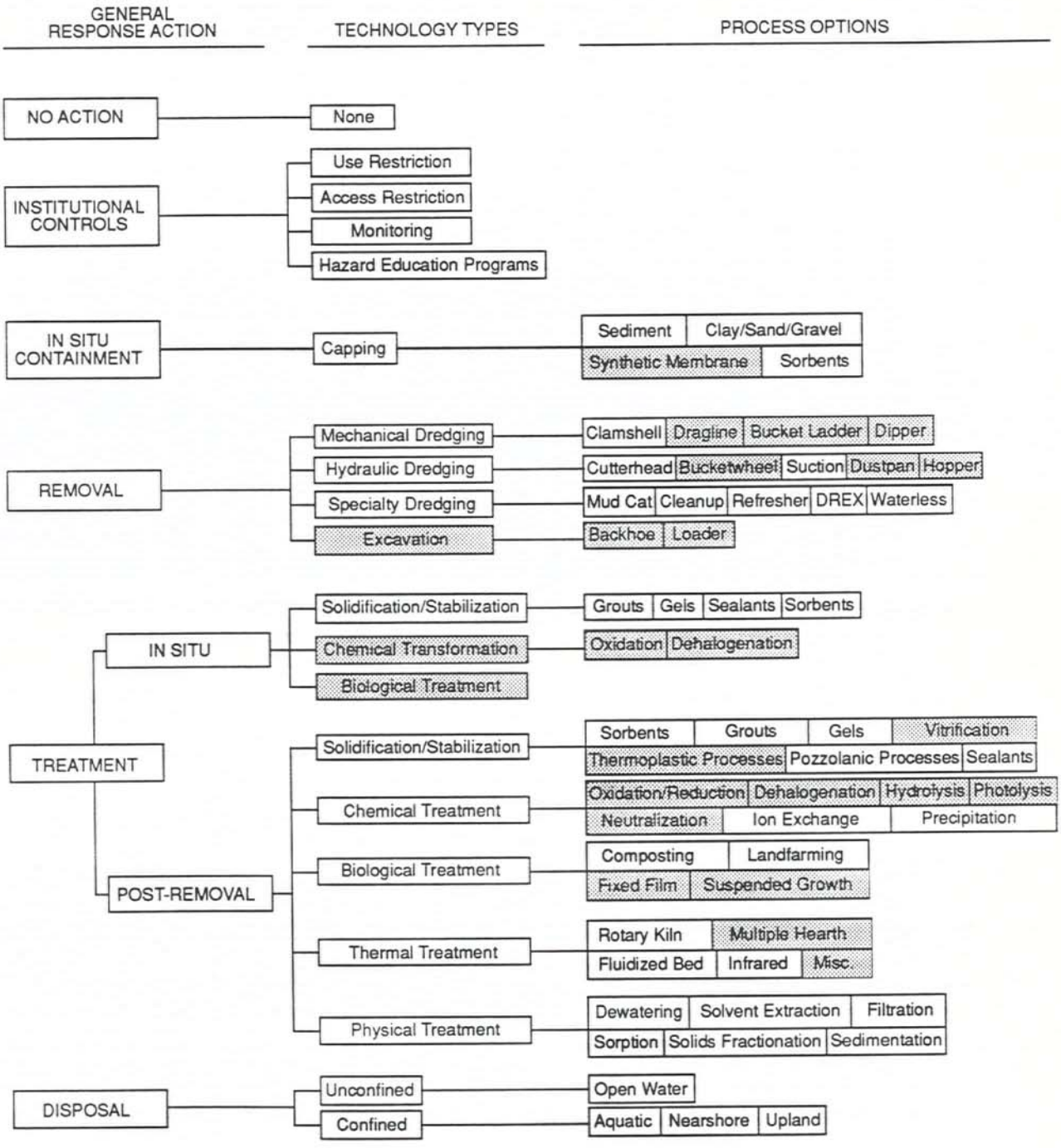
- Implementability will be evaluated according to:
  - Ability to obtain approval from governmental agencies
  - Compliance with location- and action-specific ARARs
  - Compliance with requirements for waste minimization
  - Availability of treatment, storage, and disposal services and capacity
  - Availability of necessary equipment and skilled workers

- Cost will be evaluated according to:
  - Relative capital, operation, and maintenance costs, rather than detailed estimates
  - Engineering judgment and whether costs are high, low, or medium relative to other process options in the same technology type

For example, Figure 2-6 diagrams the sediment technologies and process options retained for further evaluation at the Commencement Bay Superfund site (Tetra Tech, 1988).

Subtask 14.6: Reevaluation of Data Needs

Available information may not be adequate to describe and screen all promising technologies. There are a number of sites around the country and abroad where remediation of



SOURCE: Tetra Tech, 1989

Figure 2-6
POTENTIAL COMMENCEMENT BAY SEDIMENT REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS THAT WERE RETAINED FOR FURTHER EVALUATION AT THE COMMENCEMENT BAY SUPERFUND SITE

PAH- and metals-contaminated sediments has been evaluated and attempted. Reports from these sites as well as pertinent papers in the scientific literature will be reviewed. The purpose of this review is to evaluate innovative technologies, build on similar experiences, and make use of data generated in similar feasibility studies. Following the completion of Subtasks 14.1 through 14.5, the need for additional site characterization or treatability studies/pilot tests will be assessed and a technical memorandum will be prepared summarizing the data evaluation and recommendations.

Subtask 14.7: Assembling Alternatives

Potential remedial alternatives will be identified by selecting and combining technology types and process options that pass the prescreening process discussed above. A range of remedial alternatives will be developed, including:

- Those that include treatment that would significantly and permanently reduce the mobility, toxicity, and volume of the waste and eliminate the need for long-term monitoring
- Response actions involving little or no treatment, such as dredge and offsite disposal or in situ capping
- A no-action response

A technical memorandum will be prepared to describe the alternatives and document the assembly of general response actions into remedial action alternatives. The description of alternatives will include the assumed locations of areas to be dredged or capped, the approximate volumes of sediment to be dredged, and location of potential disposal areas.

The cost estimate of this work plan is based upon identifying five to seven potential remedial alternatives to be evaluated in the development and screening process in Task 16.

TASK 15: TREATABILITY STUDY/PILOT TESTING (PT)

This is an optional task. Should the results of Task 14 (Alternatives Identification) or Task 16 (Alternatives Development and Screening) indicate that available information is inadequate to allow a detailed evaluation of promising technologies, a treatability study or pilot test would be proposed. While the interim final RI/FS guidance document (EPA, 1988) indicates that this task typically follows Alternatives Development and Screening (Task 16), it also states that the need for treatability studies and pilot testing should be identified as soon as possible. Proposed pilot

tests based on Task 14 results might include technologies proposed in the Commencement Bay FS such as small-scale dredging to assess water quality impacts and sediment resuspension rates.

TASK 16: ALTERNATIVES DEVELOPMENT AND SCREENING (AD)

This task will involve:

- Further refinement of alternatives
- Screening of alternatives
- Deciding which alternatives to retain for detailed evaluation

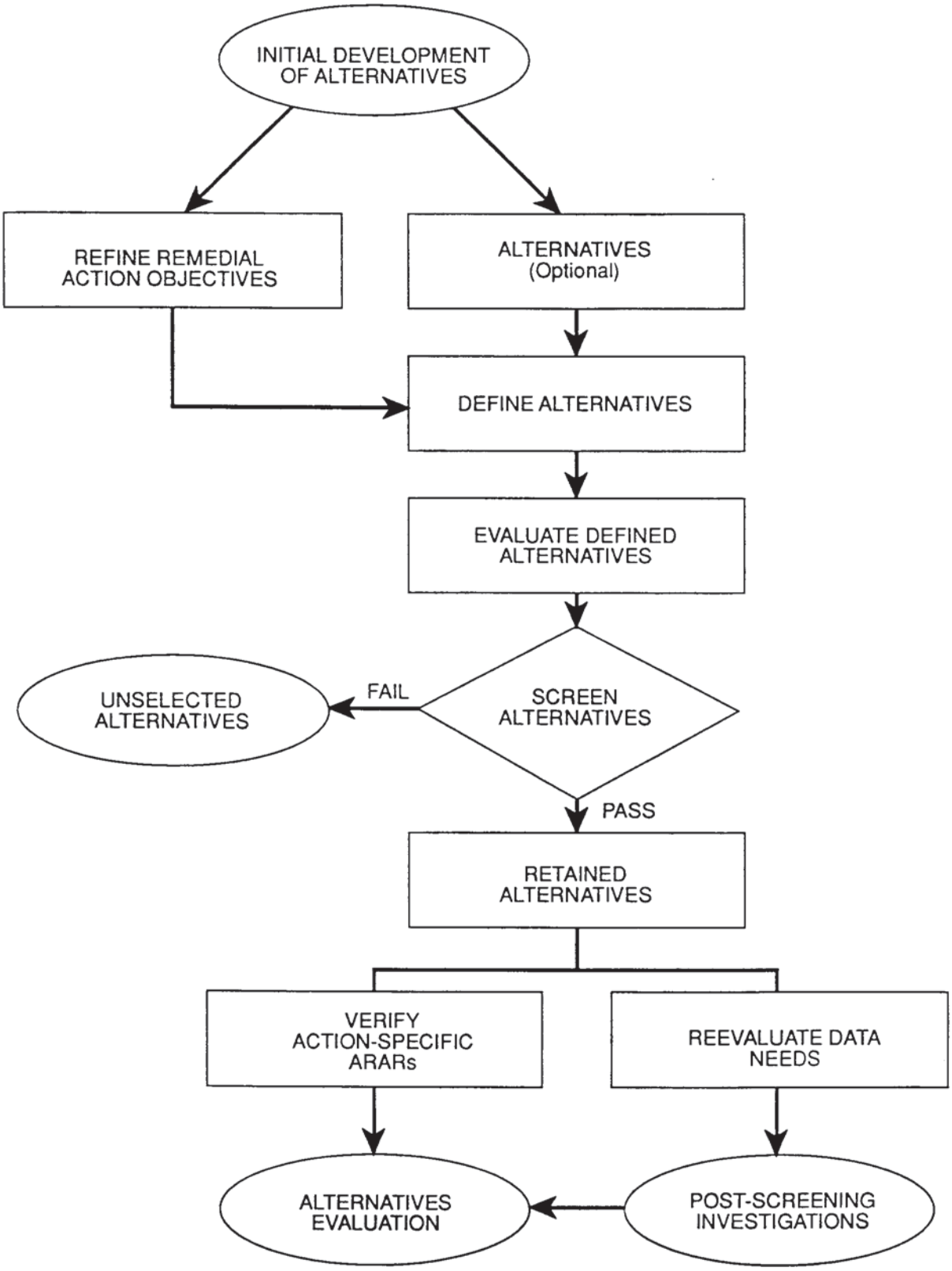
As appropriate, alternatives will be reevaluated following completion of FS tasks focused on quantifying the areas and volumes of sediment potentially requiring remediation. The sizes and capacities of the process options that make up each of the alternatives will be adjusted as needed. The remedial action objectives developed earlier will be revised to incorporate risk assessment data and to evaluate the protectiveness provided.

Alternatives will be screened against effectiveness, implementability, and cost factors. Finally, a decision will be made as to which alternatives should be retained for further analysis. Figure 2-7 outlines the major components of this task.

Subtask 16.1: Defining Media and Process Options

Alternatives will be defined to provide sufficient quantitative information to differentiate among alternatives with respect to effectiveness, implementability, and cost. This will involve:

- Refining estimates of contaminated sediment (and possibly upland soil and groundwater) and considering interaction between media
- Further defining technology process options with respect to:
  - Time frame in which treatment, capping, or removal goals can be achieved, considering the size of the system, remediation goals, and technology limits
  - Rates and flows of treatment
  - Space requirements



SOURCE: Modified from EPA, 1987

Figure 2-7
ALTERNATIVES DEVELOPMENT AND SCREENING

- Distance for offsite disposal technologies
- ARARs

Subtask 16.2: Screening Evaluation

The screening of alternatives will be based on three evaluation criteria: effectiveness, implementability, and cost. The purpose will be to reduce the number of alternatives that will undergo detailed analysis. Evaluations will be sufficiently detailed to distinguish among alternatives and to determine that alternatives are being compared on an equivalent basis.

Subtask 16.2.1: Effectiveness Evaluation. Each alternative will be evaluated relative to the other alternatives with regard to protection of human health and the environment, and reduction in toxicity, mobility, or volume. Factors used to evaluate protection will include:

- o Compliance with chemical-specific ARARs or TBCs
- o Community and worker protection during remediation
- o Length of time to achieve protection
- o Magnitude of residual or untreated waste and associated risk after remediation
- o Long-term reliability
- o Ability to prevent future exposure to residuals

The assessment of potential health risks to public and workers, either short-term or long-term, will be conducted using the compiled description of each alternative, along with anticipated exposure concentrations via identified exposure routes. At this time, the media under consideration for remedial action is sediment containing semivolatiles or inorganics. Thus drinking water and breathing air are not considered probable exposure routes.

Exposed populations, exposure scenarios, and risk estimates for each alternative will be developed based on the most currently available EPA guidance. Risk estimates are expected to be evaluated using the same methodology used in the RI no-action public health risk assessment and environmental impact assessment in order to maintain consistency in evaluation techniques and provide comparisons among the alternatives. Should more current EPA guidance indicate differences in risk assessment methodology, the no-action risk assessment may be reevaluated during the FS based on new

guidance. The Superfund Public Health Evaluation Manual (EPA, 1986) is expected to be updated in autumn 1989.

Subtask 16.2.2: Implementability Evaluation. Implementability factors will be used to evaluate the alternatives with respect to site-specific conditions. These factors include technical feasibility, administrative feasibility, and availability. Technical feasibility factors will include short-term reliability during remediation, compliance with action-specific ARARs, ability to monitor effectiveness of the remedy, and ability to perform operation and maintenance for as long as necessary.

Administrative feasibility will include the ability to obtain approvals from other agencies and compliance with location-specific ARARs.

The availability of technology capacity and resources will involve evaluating the availability of treatment, storage, and disposal services and capacity.

Subtask 16.2.3: Cost Evaluation. The focus will be to make cost estimates for each alternative of comparable accuracy. Cost estimates will be based on a variety of data that may include cost curves, generic unit costs, vendor information, conventional cost-estimating guides, and prior similar estimates modified by site-specific information.

Capital costs may include construction, land and site development, buildings and services, and relocation of populations. Operation and maintenance costs (annual and long-term) will include operating labor, maintenance material and labor, auxiliary material and energy, purchased services, and disposal. Present worth analyses will be used. A discount factor of 5 percent and a planning period of 30 years will be used.

Subtask 16.2.4: Innovative Technologies. Innovative technologies will be carried through screening if there is reason to believe they offer significant advantages (better treatment, implementability, fewer adverse impacts, or lower costs). Other full-scale applications under similar situations or bench- or pilot-scale treatability testing can be used in support of innovative technologies.

Subtask 16.2.5: Alternative Selection Process Report. In this subtask, several technical memoranda will be prepared and submitted to EPA describing the ongoing development and screening of alternatives completed through Subtask 16.2.4. Three memorandums are planned according to the following project milestones:

- Preliminary memorandum at the end of July 1989, following completion of the review of the

Commencement Bay technology screening and alternatives development reports and following clarification of depth of contamination visually identified during Task 5 and Subtask 7.1.

- Followup memorandum at the end of December 1989, following completion of upland field activities at Wyckoff (Task 4) and the optional subtidal drilling (Subtask 7.2).

- A final technical memorandum in May 1990, following evaluation of all field data.

The additional field data will provide information related to the vertical extent of material that may require remediation, and thus will impact the alternatives development, and will indicate the need for source control measures prior to sediment remediation. Source control measures will not be included in the alternatives under development.

As appropriate, these technical memoranda will include:

- Definition of each alternative, including extent of remediation, volume of contaminated material, physical size of major alternative features, process parameters, cleanup timeframes, transportation distances, and special considerations

- Chemical- and risk-based remedial objectives for each alternative

- Screening evaluation summaries for each alternative

- Comparison of screening evaluations among alternatives

- The need for additional treatability studies or field data

Each of these technical memoranda will document the methods, rationale, and results of the ongoing alternatives screening and will serve as the basis for the FS chapter on screening of alternatives.

A meeting with the Eagle Harbor Technical Discussion Group will be held following the first and second memoranda to review this task's results. The first meeting will include a discussion of action-specific ARARs and the overall alternatives screening process.

TASK 17: ALTERNATIVES EVALUATION (AE)

The detailed analysis of selected alternatives provides information to allow remedy comparison and selection. The following nine criteria will serve as the basis for conducting the detailed evaluation:

1. Short-term effectiveness
2. Long-term effectiveness and protectiveness
3. Reduction of toxicity, mobility, or volume
4. Implementability
5. Cost
6. Compliance with chemical-, location-, and action-specific ARARs
7. Overall protection of human health and the environment
8. State acceptance
9. Community acceptance

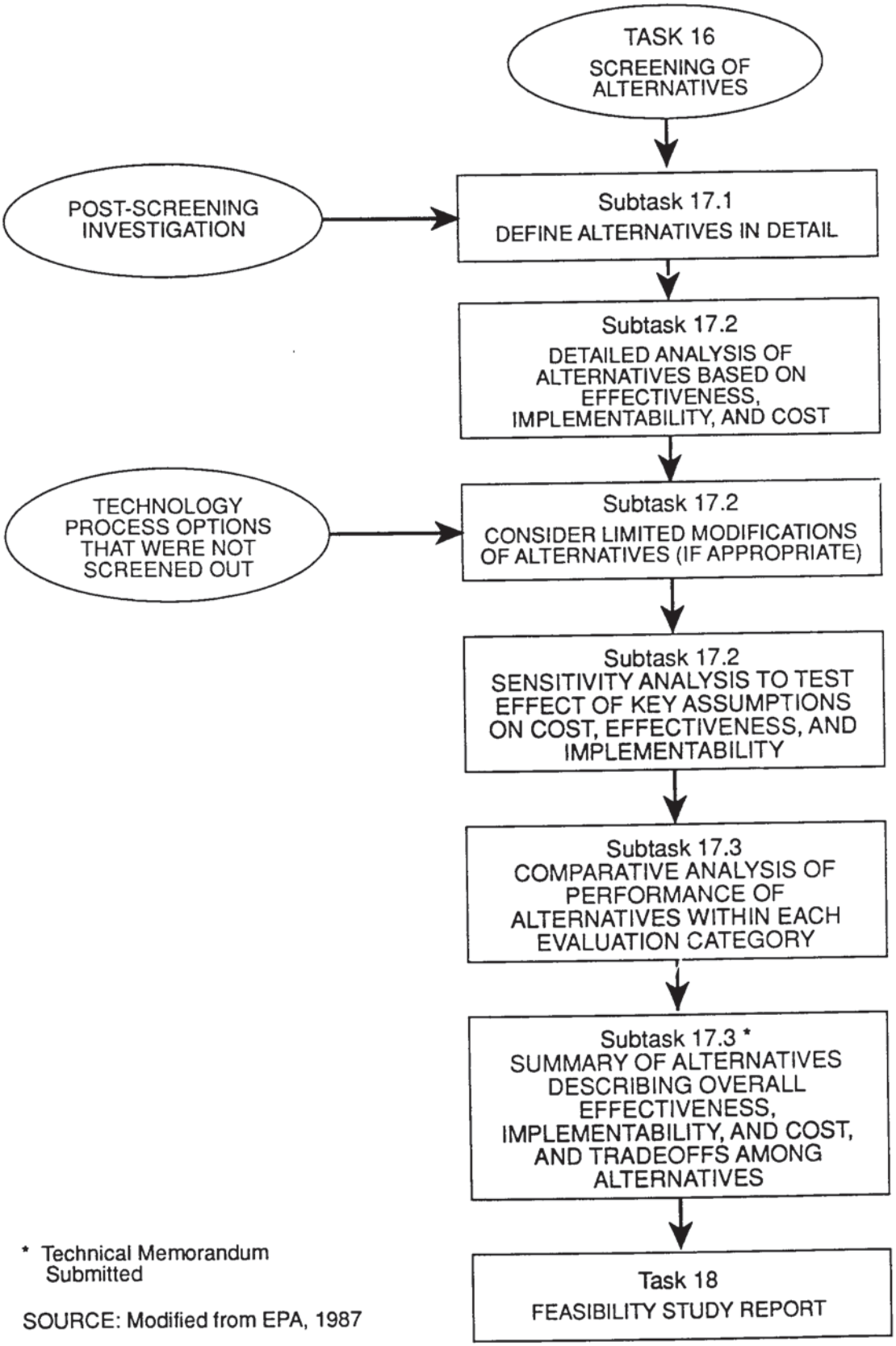
The detailed analysis phase will incorporate any treatability and site characterization information collected during the postscreening investigation. Figure 2-8 outlines major components of this task.

Subtask 17.1: Alternative Definition

This subtask will involve further definition of each alternative, if appropriate, with respect to the volumes or areas of contaminated sediment to be addressed, technologies to be used, and any performance requirements associated with those technologies, in order to consistently apply evaluation criteria and develop order-of-magnitude cost estimates.

The information developed to define alternatives at this stage will consist of preliminary design calculations, approximate sizing of key process components, conceptual site layouts, and a discussion of limitations, assumptions, and uncertainties.

The alternatives will be configured to present the decision-maker with a range of options addressing the entire site.



* Technical Memorandum Submitted

SOURCE: Modified from EPA, 1987

Figure 2-8
ALTERNATIVES EVALUATION

Subtask 17.2: Analyses Factors Overview

This subtask will provide an analysis of each alternative against the nine evaluation criteria, as follows:

- o Short-term effectiveness. This will include the impacts of the alternative during the construction and implementation phase until remedial objectives are met. It will include risk to the community, protection of workers, environmental impacts, and time needed to achieve protection.

- o Long-term effectiveness and protectiveness. This will involve evaluating risk remaining at the site after response objectives have been met. Treatment residuals or untreated wastes will be the focus. The relative magnitude of risk and adequacy and reliability of controls for long-term waste management will be evaluated.

- o Reduction of toxicity, mobility, and volume. This evaluation will focus on the following specific factors for each remedial action:

  - The treatment process that each action will employ and the treatment media

  - The degree of expected reduction in toxicity, mobility, or volume, measured as a percentage of reduction

  - The degree to which treatment will be irreversible

  - The type and quantity of treatment residuals that will remain and how they will be managed

- o Implementability. This criterion will involve analysis of the following factors:

  - Technical feasibility, including construction and operation difficulties (e.g. ferry traffic) or unknowns; reliability in meeting process efficiencies or performance goals; ease of undertaking additional remedial actions, if applicable; and monitoring considerations

  - Administrative feasibility, including time and ability to obtain approvals from other agencies and activities needed to coordinate with other agencies

- Availability of services and materials, including adequacy of offsite treatment, storage capacity, and disposal services; availability of equipment, specialists, and technologies; and special consideration of these factors for innovative technologies, if applicable

o Cost. The following items will be addressed:

- Capital Costs

  Direct and indirect costs, including dredging, construction, equipment, land, site development, buildings and services, relocation and disposal costs, engineering expenses, legal fees, license or permit costs, startup and shakedown costs, and contingency allowances.

- Annual Costs

  Post-remediation costs necessary to evaluate the continued effectiveness of a remedial action, including operating labor costs, maintenance materials and labor, operating materials and energy, disposal of residues, purchased services, administrative costs, insurance, taxes and licensing costs, maintenance reserve contingency funds, rehabilitation costs, costs of periodic reviews, and, where appropriate, future remediation costs.

- Accuracy of Cost Estimates

  Within the limits of order-of-magnitude procedures, the costs will provide an accuracy of approximately +50 to -30 percent. Other expected accuracies will be identified.

- Present Worth Analysis

  A discount rate of 5 percent before taxes and after inflation is assumed. Estimates of costs in each of the planning years will be made for constant dollars, representing the capital and operating and maintenance (O&M) costs at the time of the estimate. The period of performance will not exceed 30 years.

- Cost Sensitivity Analysis

  A sensitivity analysis will be considered if there is sufficient uncertainty concerning specific assumptions, where the factors would significantly change overall costs of an alternative with only a small change in their values.

o Compliance with Chemical-, Location-, and Action-specific ARARs. The detailed analysis will summarize what the federal, state, and local ARAR are and how the alternative meets these. If an ARAR is not met, the basis for justifying one of the six waivers under CERCLA will be discussed. If appropriate, other criteria to be considered (TBC) will be included.

o Overall Protection of Human Health and the Environment. This assessment will be based on a composite of factors assessed under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The evaluation of overall protectiveness will focus on how an alternative achieves protection over time and how site risks are reduced, indicating how each source of contamination is to be eliminated, reduced, or controlled.

o State Acceptance. This assessment will evaluate the technical and administrative issues Ecology may have concerning each of the alternatives. This analysis will include the process used to obtain input from Ecology during preparation of the RI/FS, including meetings, opportunities for review, and transmittal of comments. This discussion will include:

  - Features supported by Ecology
  - Reservations of Ecology
  - Oppositions of Ecology

o Community Acceptance. If the community position on specific alternatives has been documented during preparation of the RI/FS, the FS will address:

  - Features supported by the community
  - Reservations of the community
  - Oppositions of the community

Subtask 17.3: Comparison of Alternatives

Alternatives will be compared with each other relative to the nine evaluation criteria given in Subtask 17.2. This section of the FS report will include a narrative discussion describing the relative strengths and weaknesses of the alternatives with respect to each criterion, and how reasonable variations or key uncertainties could change the expectations of their relative performance. Substantive differences will be focused upon. Potential advantages of innovative technologies will be discussed. A table will summarize the significant differences among the alternatives with respect to each criterion. The results of the comparatives analysis will be used to highlight the relative advantages and disadvantages of each alternative so that key tradeoffs can be identified.

A technical memorandum summarizing the detailed evaluations of alternatives will be prepared and submitted to EPA. The technical memorandum will document the methods, rationale, and results of the alternatives evaluation and serve as the basis for the chapter in the FS report on detailed analysis of alternatives.

FEASIBILITY STUDY REPORTS

TASK 18: FS REPORT PREPARATION (R4)

A detailed outline of the FS report with as much text as possible will be submitted following the completion of Task 14.

The preliminary draft FS report summarizing the development and evaluation of alternative remedial actions will be prepared, receive CH2M HILL QA review, and be submitted to EPA for review. After receipt of EPA's review comments, a draft report will be prepared and submitted to the Eagle Harbor Technical Discussion Group and other interested parties. After comments are received, a final draft report for public review will be prepared and submitted to EPA.

In order to estimate word processing, reprographics, editorial, and postage costs, the following number of drafts (with appendixes) and pages are assumed.

Report	Pages	Copies	Total Impressions
Internal Review Draft	800	20	16,000
First Agency Review Draft	800	40	32,000
Second Draft (single space)	600	80	48,000
Final FS Report	600	80	48,000

The FS report format, suggested in the EPA draft guidance (Table 2-5), will be used as applicable.

MISCELLANEOUS SUPPORT

TASK 19: PROJECT MANAGEMENT (PM)

This task covers all management activities, including staff assignments and oversight, scheduling of activities, detailed instructions, procuring and managing subcontractors, coordination with EPA, cost control and accounting, monthly REM IV reports, and responding to requests for information from EPA.

TASK 20: QUALITY CONTROL (QC)

A CH2M HILL review team has been selected and a review team leader (RTL) appointed. The RTL will be responsible for identifying qualified personnel to review each project deliverable. The review team will be integrated into project planning and coordination. The RTL and selected members of the review team will:

- Attend FS kickoff meeting
- Review draft work plan
- Attend technical concept meetings
- Audit progress of the work
- Provide technology transfer
- Provide experienced guidance to site manager
- Participate in major milestone decisions
- Review key deliverables
- Review preliminary and draft reports

TASK 21: EXTERNAL MEETINGS (MG)

Meetings will be held between CH2M HILL and EPA to develop project plans and objectives and to review information and project deliverables. It is assumed that 12 meetings will be held at EPA Region 10 in Seattle and will involve the SM, appropriate task managers, and/or technical staff.

In addition, it is assumed that five meetings will be held with CH2M HILL, EPA, and the Eagle Harbor Technical Discussion Group to review the project approach and objectives, to exchange information, and to receive comments on phases of the RI/FS. These meetings will be held at or near EPA's Seattle office. These meetings are as follows:

- August 1989: Review preliminary source identification

Table 2-5
FS REPORT FORMAT

Executive Summary

1 Introduction

1.1 Purpose and Organization of Report

1.2 Background Information (Summarized from RI Report)

1.2.1 Site Description
1.2.2 Site History
1.2.3 Nature and Extent of Contamination
1.2.4 Contaminant Fate and Transport
1.2.5 Baseline Risk Assessment

2 Identification and Screening of Technologies

2.1 Introduction

2.2 Remedial Action Objectives

Presents the development of remedial action objectives for each medium of interest (i.e., intertidal and subtidal sediment). For each medium, the following will be discussed:

- o Contaminants of interest
- o Allowable exposure based on risk assessment
- o Allowable exposure based on ARARs
- o Development of Remedial Action Objectives

2.3 General Response Actions

For each medium of interest, describes the estimation of areas or volumes to which treatment, containment, or exposure technologies may be applied

2.4 Identification and Screening of Technology Types and Process Options

For each medium of interest, describes:

2.4.1 Identification of Technologies

2.4.2 Evaluation of Technologies and Selection of Representative Technologies (Screen for Implementability)

Table 2-5
(continued)

3 Development and Screening of Alternatives

3.1 Development of Alternatives

Describes rationale for combination of technologies/media into alternatives. Note: This discussion may be by medium or for the site as a whole.

3.2 Screening of Alternatives

3.2.1 Introduction
3.2.2 Alternative 1
- o Description
- o Evaluation
- o Effectiveness
- o Implementability
- o Cost

3.2.3 Alternative 2
- o Description
- o Evaluation

3.2.4 Alternative 3
3.2.5 Summary of Screening

4 Detailed Analysis of Alternatives

4.1 Introduction

4.2 Alternative Analysis

4.2.1 Alternative 1
4.2.1.1 Description
4.2.1.2 Assessment
- o Short-Term Effectiveness
- o Long-Term Effectiveness and Permanence
- o Reduction of Mobility, Toxicity, and Volume
- o Implementability
- o Cost
- o Compliance with ARARs
- o Overall Protection
- o State Acceptance
- o Community Acceptance

4.2.2 Alternative 2
4.2.2.1 Description
4.2.2.2 Assessment
4.2.3 Alternative 3
4.2.4 Summary of Alternatives Analysis

Table 2-5
(continued)

4.3 Comparison Among Alternatives

- 4.3.1 Short-Term Effectiveness
- 4.3.2 Long-Term Effectiveness and Permanence
- 4.3.3 Reduction of Mobility, Toxicity, and Volume
- 4.3.4 Implementability
- 4.3.5 Cost
- 4.3.6 Compliance with ARARs
- 4.3.7 Overall Protection
- 4.3.8 State Acceptance
- 4.3.9 Community Acceptance
- 4.3.10 Summary of Comparisons Among Alternatives

4.4 Summary of Detailed Analysis

Bibliography

Appendixes

A. Specifications of Major ARARs and TBCs
B. Source Characterization of Wyckoff Facility
C. Source Characterization of North Shipyard Area
D. Vertical Distribution of Contamination
E. Hydrogeology of Eagle Harbor
F. Source Identification and Loading Estimates
G. Evaluation of Sediment Recovery
H. Method for Estimating Costs of Sediment Remedial Alternatives

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Note: Results of other site characterization and treatability studies (if completed) will be included as appendixes.

- January 1990: Review supplemental site characterization field results and preliminary alternatives screening results
- June 1990: Review alternatives evaluation results
- August 1990: Review FS Report

TASK 22: COMMUNITY RELATIONS (CR)

The purpose of this task is to provide support to EPA in preparing and conducting public meetings. The current EPA community relations plan developed during the RI will be reviewed by CH2M HILL and EPA and refined by EPA as applicable. CH2M HILL will help EPA conduct public meetings associated with this FS. It is assumed that two public meetings will be held in Winslow.

Section 3
PROJECT SCHEDULE

The estimated schedule of deliverables is shown in Table 3-1. The estimated timing of activities is shown in Figure 3-1. This schedule is considered to be very ambitious and has been developed based on specific assumptions, such as:

- The central harbor does not have a continuous source of PAH contamination
- Alternatives will be evaluated based on a range of order-of-magnitude volumes and areas requiring remediation. Two scenarios will be evaluated, a high volume and area and a low volume and area
- Detailed volume and area estimates will be calculated during remedial design following the record of decision (ROD)
- No source control alternatives will be evaluated
- Only six wells will be needed for Task 4
- Access to sample locations will be available when needed
- If treatability study is needed, it can be accomplished in 2 months
- Laboratory turnaround times will be 6 weeks or less
- No changes will occur to this FS work plan

The schedule will change should changes occur to these assumptions or to other components of this work plan. A flow chart showing the decision points for the key activities is shown in Figure 3-2.

Table 3-1
TENTATIVE SCHEDULE OF DELIVERABLES

	Task Deliverables	Estimated Due Date
1	Work Plan Preparation (WP)	
	First Draft	April 7, 1989
	Second Draft	April 19, 1989
	Final FS Work Plan	July 11, 1989[a]
2	Source Identification (ED)	
	Technical Memorandum--Fingerprint Data Evaluation Results	August 25, 1989
	Technical Memorandum--Preliminary Central Harbor Source Identification	November 15, 1989
	Technical Memorandum--Final Source Identification	April 15, 1990
3	QAPP/FSP and SSP Preparation (QS)	
	Amendment 2; Diver Survey first draft/final QAPP/FSP and SSP	May/June 9, 1989
	Amendment 3; Subsurface Geophysics first draft/final QAPP/FSP	July 18/July 25, 1989[a]
	Amendment 4; Deep Sediment Sampling first draft/final QAPP/FSP	August 7/August 21, 1989[a]
	Amendment 5; Shipyard Characterization	One month after receipt of DOT data
4	Wyckoff Source Characterization (FT)	
	QAPP/FSP and SSP (QS) Draft Amendment/Final	July 20/August 11, 1989
	Field Memorandum	One month following completion of fieldwork
	Data Validation	December 1989 through February 1990
	Data Evaluation Technical Memorandum	March 1990
9	Field Support	
	Field Memorandum--Diver Survey and Sediment Sampling (Task 5)	One month following completion of fieldwork
	Field Memorandum--Subsurface Geophysics and Hydrology(Task 6)	One month following completion of fieldwork
	Field Memorandum--Deep Sediment Samples (Task 7)	One month following completion of fieldwork
	Field Memorandum--Shipyard Source Characterization (Task 8)	One month following completion of fieldwork
11	Data Validation (DV)	
	Draft Quality Assurance Reports	Through February 1990[b]
	Final Data Report	March 23, 1990

Table 3-1
(continued)

Task Deliverables	Estimated Due Date
12 Sedimentation Rate Evaluation (MD)	
Technical Memorandum	August 15, 1989
13 Data Evaluation	
Technical Memorandum--Diver Survey	August 25, 1989
Technical Memorandum--Geophysics	August 31, 1989
Technical Memorandum--Subtidal Hydrology	September 15, 1989
Technical Memorandum--Deep Sediment Characterization	November 20, 1989
Technical Memorandum--Shipyard Source Characterization	January 10, 1990
14 Alternatives--Technology Screening (AT)	
Technical Memorandum--Technology Screening	July 21, 1989
Technical Memorandum--Baseline Condition ARAR Analysis	July 14, 1989
Technical Memorandum--Remedial Action Objectives Development	July 24, 1989
Technical Memorandum--Need for Treatability Studies	October 1989
15 Treatability Study/Pilot Testing (PT)	
Study Plan (if task needed)	November 17, 1989
16 Alternatives Development and Screening (AD) Technical Memorandum	
-Preliminary Memorandum	August 14, 1989
-Interim Memorandum	December 11, 1989
-Final Memorandum	February 16, 1990
17 Alternatives Evaluation (AE)	
Technical Memorandum	March 5, 1990
18 FS Report Preparation (R4)	
Detailed Outline/Working Draft	September 8, 1989
First Draft FS Report	April 6, 1990
Second Draft FS Report	May 25, 1990
Final FS Report (Public Comment)	June 29, 1990

[a]Assumes reviewers' comments will be received within 2 weeks.

[b]Assumes CLP Laboratory turnaround time of 30 days.

No.		TASK DESCRIPTION	1989 MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1990 JAN	FEB	MAR	APR	MAY	JUN
1		Work Plan Preparation (WP)	▪▪▪	▪D*D	*▪▪	▪▪▪F												
2		Source Identification (ED)				▪	▪▪▪M				▪▪	M			▪	▪▪M	M	
3		QAPP/FSP/SSP Preparation (QS)																
		Task 5: Amendment 2			▪▪D*	F												
		Task 6: Amendment 3				▪▪	D*F											
		Task 7: Amendment 4					▪▪D	*F										
		Task 8: Shipyard Source Characterization (F4)					▪▪	D*F										
4		Wyckoff Source Characterization (FT)					BB	BBB	XXXX	XXXX								
		QAPP/FSP and SSP Amendment				▪▪	▪▪D*	F										
		Field Memorandum								▪▪	▪M							
		Close Support Laboratory							.....	.....								
		CLP Laboratory Analyses							..	.....	.....							
		Data Validation										▪▪▪	*F					
		Data Evaluation/Technical Memorandum											▪▪	▪▪▪▪	M**F			
5		Diver Survey/Sediment Sampling (F1)				X▪▪	▪▪▪M											
6		Subsurface Physical Characterization (FP)																
		6.1 Subsurface Geophysics					BBX	▪D*F										
		6.2 Subsurface Hydrology						X▪D	*F									
7		Deep Sediment Sampling (F2)						XX	▪▪D*	M								
8		Shipyard Source Characterization (F4)						X	X▪▪▪	M								
9		Fieldwork Support (FK)				.....	.....	.....	.....	.....	.....	.....	.....	.....				
10		Close Support Laboratory					.....	.....										
		CLP Laboratory Analyses					▪▪▪▪	▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪							
11		Data Validation (DV)						▪▪		▪▪▪M		▪▪▪▪	▪▪M					
12		Sedimentation Rate Evaluation (MD)				▪▪	▪▪▪▪	▪M										
13		Data Evaluation (DE)						▪▪M	▪▪M		▪▪M		▪▪M					
14		Alternatives - Technology Screening (AT)				▪▪▪	▪M*		▪	▪M*	M							
		ARAR Technical Memorandum				▪▪	▪M*											
		Remedial Action Objectives Memo				▪▪	▪M*											
15		Treatability Study/Pilot Testing (PT)								??	??(▪	▪▪▪▪	▪▪M	M)				
16		Alternatives Development and Screening (AD)					▪▪▪	M*		▪▪	▪M*	▪▪	▪▪M	*F				
17		Alternatives Evaluation (AE)											▪▪▪▪	▪▪M	*F			
18		OUFS Report Preparation (R4)						▪ ▪	M				▪ ▪	▪ ▪	▪ ▪	D**▪	▪▪D*	*▪▪F
19		Project Management (PM)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20		Quality Control (QC)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
21		External Meetings (MG)				▪	▪	+	▪	▪	▪	+	▪	▪	▪	+	▪	▪
22		Community Relations (CR)														▪	▪	▪

EXPLANATION

...	Ongoing Activity	D	Draft Report
▪▪▪	Scheduled Activity	F	Final Report
XXX	Field Work	B	Subcontractor Bid
M	Technical Memorandum	+	Technical Discussion Group Meeting
*	Review Period		

Figure 3-1
EAGLE HARBOR FS SUMMARY SCHEDULE

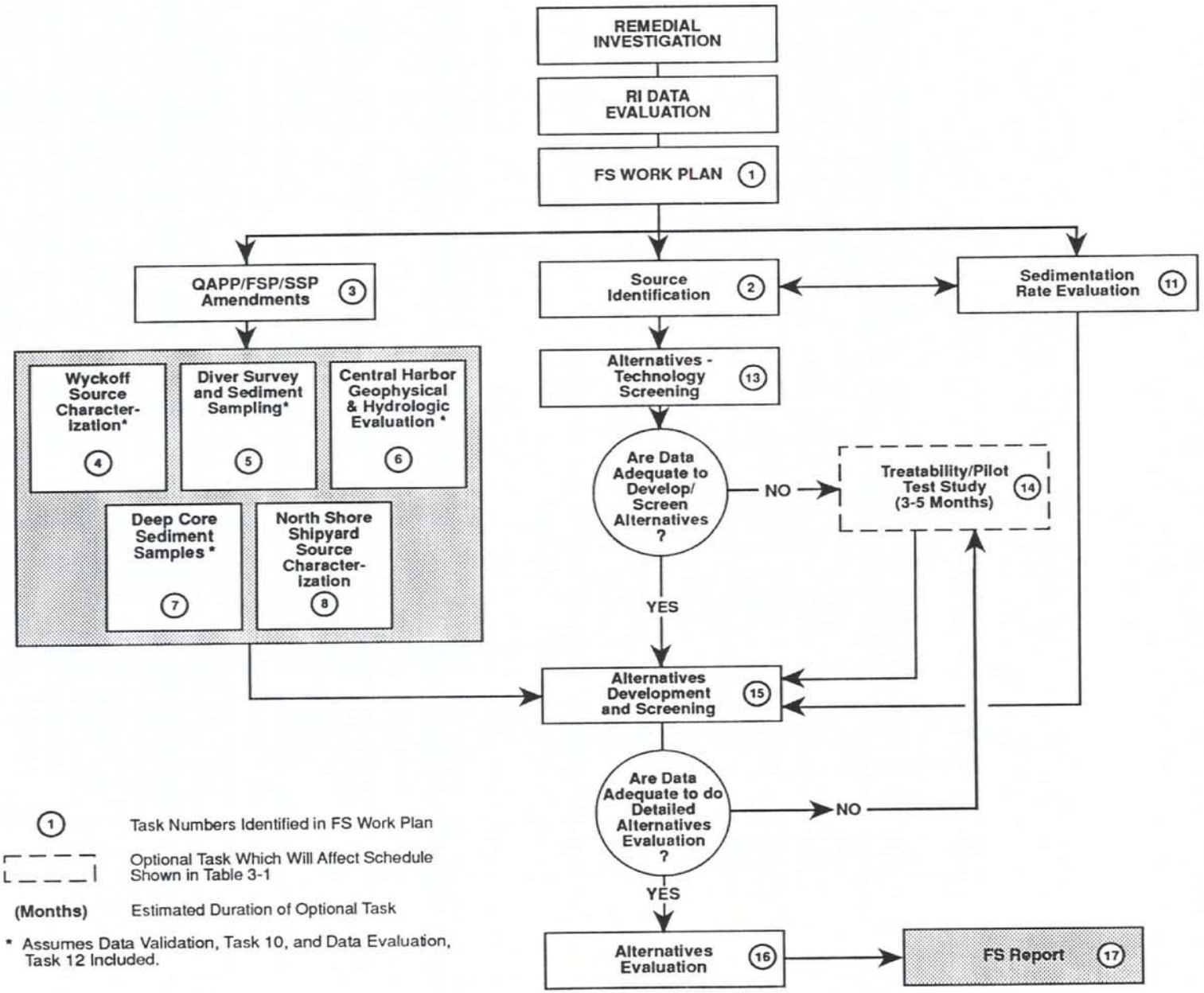

Figure 3-2
FS TASK FLOW DIAGRAM

Section 4
PROJECT MANAGEMENT PLAN

CORE PROJECT STAFF

The core project staff of the Eagle Harbor FS, shown in Figure 4-1, is described in this section.

EPA REMEDIAL PROJECT MANAGER (RPM)

David Tetta is the RPM for this project. Ellen Hale is the alternate RPM.

EPA COMMUNITY RELATIONS

Timothy Brincefield will help the RPMs conduct community relations activities.

QUALITY ASSURANCE MANAGER (QAM)

Bruce Woods will be the EPA Region 10 QAM responsible for finalizing the QA objectives, providing SAS instructions to CLP laboratories, and approving QA reports.

TECHNICAL DISCUSSION GROUP (TDG)

The Eagle Harbor TDG was formed to solicit technical comments from PRPs, agencies, citizen groups, and other interested parties and to facilitate timely communication on the progress of the RI/FS. Organizations participating in the TDG are listed in Table 4-1.

SITE MANAGER (SM)

Walter Shields will serve as site manager. He will be responsible for overall management of the Eagle Harbor RI/FS.

FEASIBILITY STUDY LEADER

Jane Gendron will serve as task leader for the feasibility study. She will be responsible for coordinating the specific tasks listed in this work plan. Ms. Gendron will coordinate with the SM regarding overall status and management of the FS portion of the project.

PROJECT ASSISTANT

The project assistant, Linda Evjen, will assist the SM in coordination with the REM IV Zone Project Management Office cost control, records management, and monthly reporting to EPA. Ms. Evjen will also assist the SM in procurement and monitoring of subcontractors.

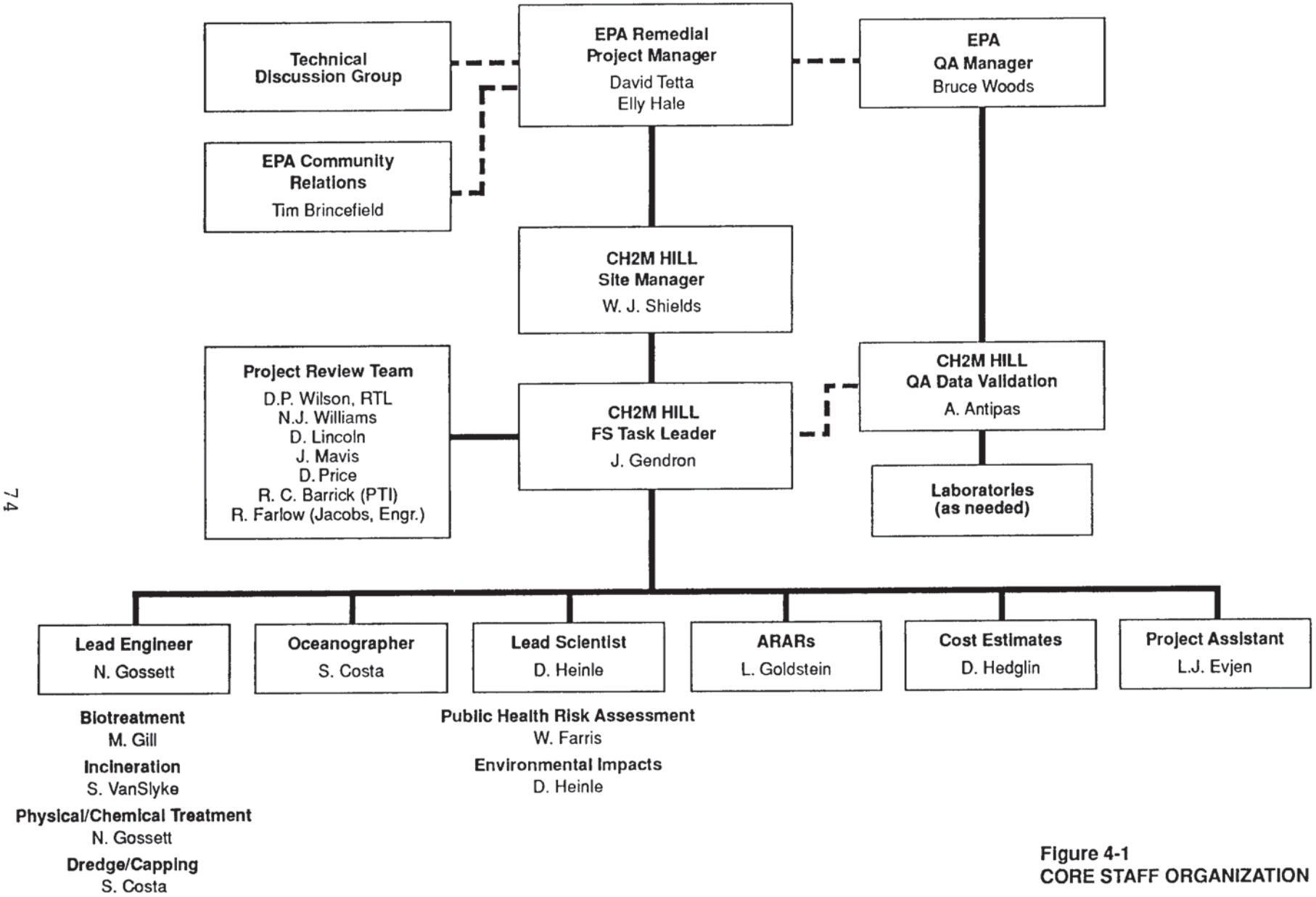

Figure 4-1
CORE STAFF ORGANIZATION

Table 4-1
ORGANIZATIONS IN THE EAGLE HARBOR
TECHNICAL DISCUSSION GROUP

Agency for Toxic Substances and Disease Registry
Association of Bainbridge Communities
Bainbridge Marine Services
Chevron Oil Corporation
Eagle Harbor Condominium Association
Friends of Eagle Harbor
Greenpeace
Kitsap County Health Department
National Oceanic and Atmospheric Administration
PACCAR
Puget Sound Water Quality Authority
Shell Development Company
Shell Oil
Suquamish Indian Tribe
Todd Shipyard Corporation
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service
Washington State Department of Ecology
Washington State Department of Fish and Wildlife
Washington State Department of Natural Resources
Washington State Department of Social and Health Services
Washington State Department of Transportation
Washington Toxics Coalition
Wyckoff Company

LEAD ENGINEER

Nancy Gossett will serve as lead engineer, responsible for coordinating the treatment-related technology screening effort, assisting in alternatives development and definition, and conducting the engineering evaluation of alternatives.

LEAD SCIENTIST

Donald Heinle will serve as lead scientist, responsible for planning all public health and environmental assessments of the alternatives. He will also assist in alternatives development and evaluation.

OCEANOGRAPHER

Steven Costa will be responsible for the sediment rate evaluation as well as the removal and containment technology components of potential alternatives. He will also assist in alternatives development and definition.

ARARs

Libby Goldstein will be responsible for evaluation of site specific ARARs for the no-action alternative, as well as for the developed alternatives.

COST ESTIMATING

David Hedglin will be responsible for evaluating and assembling associated costs related to the initial technologies during the preliminary screening, as well as costs related to the developed alternatives.

QUALITY ASSURANCE OFFICER

Artemis Antipas is the CH2M HILL analytical chemist responsible for data validation and QA/QC assessments.

PROJECT REVIEW TEAM

The review team will participate in project planning and will provide technical review of major project deliverables. The team consists of David Wilson, the review team leader (RTL); Jim Mavis, David Price, David Lincoln, Noel Williams, all of CH2M HILL; Robert Barrick of PTI Environmental Services, Inc.; and Raleigh Farlow of Jacobs Engineering Group.

COORDINATION WITH EPA

The SM will have primary responsibility for coordinating all aspects of the work with the EPA RPM. The FS task leader will share responsibility and will serve as an alternate contact for EPA.

COORDINATION WITH REM IV ZPMO

The REM IV Region 10 regional manager (RM), Kathy Lombardo, will provide the SM with overall program guidance on key technical and policy issues provided by the Zone II Project Management Office.

COORDINATION WITH OTHER AGENCIES

The EPA RPM will maintain all official project contacts with other agencies, groups, and individuals. Project team members will assist the EPA with such contacts only if specifically requested or approved by the RPM.

REM IV ZONE PROGRAM MANAGEMENT PLAN

The Eagle Harbor FS will be performed in general compliance with the REM IV Zone Program Management Plan (Contract 68-01-7251), current version.

Section 5
SUBCONTRACTING PLAN

The Eagle Harbor supplemental fieldwork will include participation of professional service subcontractors and service subcontractors. This section discusses the plan by which their participation will be managed and directed by CH2M HILL; the plan is consistent with the REM IV Zone Program Management Plan. The SM will prepare technical specifications and purchase orders for the subcontractors in coordination with the REM IV subcontracts administrator.

PROFESSIONAL SERVICES

Professional service subcontracts may be used during the execution of the project to provide specific technical expertise and additional capability for portions of the work. Professional services will be procured through (in order of preference) task order execution within existing REM IV basic ordering agreements (BOAs), specific request for qualifications (RFQ) with selection on qualifications and negotiation, or sole-source procurement in extremely specialized circumstances.

SERVICE SUBCONTRACTS

Service subcontracts currently identified are:

- Vendor to drill boreholes and install wells at the Wyckoff facility and possibly in the subtidal zone
- Vendor to provide deep core sampler
- Vendor to provide geophysical sensing equipment
- Vendor to drill shallow boreholes in the historical shipyard area
- Vendor to accept and dispose of RI-derived waste materials

Appendix A
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Appendix A
REFERENCES

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Appendix B
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